SOUTHERN PACIFIC LINES

COMMON STANDARD SPECIFICATION CSL-1007

FOR A 4-8-4 TYPE LOCOMOTIVE

CLASS GS-4 OR GS-80 $\frac{25\frac{1}{2}}{32}$ $\frac{276}{\text{B-109}}$ -SF

Dated June 15, 1940

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GENERAL DESCRIPTION

GENERAL DESIGN	See drawing entitled "ERECTING DIAGRAM."	
MINIMUM CLEARANCE	See drawing furnished showing minimum clearances.	
GENERAL DIMENSIONS	Gage	4' 8-1/2"
	Curvature, Maximum	18 degrees
	Cylinders, diameter and stroke	25½ x 32"
	Diameter of Driving Wheels	80" Outside
	Diameter of Engine Truck Wheels	36" Outside
	Diameter of Trailing Truck Wheels	45-1/2" Outside
	Driving Wheel Base (Rigid)	14' 0"
	Driving Wheel Base (Total)	21' 6"
	Wheel Base of Engine	47' 8"
	Wheel Base of Engine and 23,500 Gallon Tender	95' 10-1/2"
	Length of Engine and 23,500 Gallon Tender over all	110' 3-3/4"

Height, top of rail to top of stack	16' 4"
Height of cab at eaves, measured from top of rail center of eaves radius about	12' 4-1/2"
Width of cab over shields	10' 4-1/4"
Width of cab over eaves	10' 0"
Width over cab running boards	10' 10"
Width over cab handles	10' 0-7/8"
Width over cylinder casings	10' 9"
Width, Maximum (Not to exceed)	10' 11"
Center line of boiler from top of rail	10' 8"
Center to center of cylinders	7' 10"
Center to center of frames	40"
Boiler pressure	300Lbs.per sq. in.
Boiler, diameter of first course, outside	86"

ENGINE WEIGHTS

LOADED WEIGHTS	Weight on first drivers (must not exceed)	69,000	Lbs.
	" " second " (" " ")	69,000	"
	" " third " (" " ")	69,000	"
	" " fourth " (" " ")	69,000	"
	" " engine truck (approximately)	83,300	" ø
	" " trailing truck(approximately)	109,400	" øø
	Total weight on drivers	276,000	"
	Total weight of engine - loaded	469,000	"
LIGHT WEIGHT	Total weight of engine, light	425,000	"

ø -Weight may be decreased
øø -Weight may be increased

METHOD OF OBTAINING WEIGHTS

The builder must furnish Railroad Company with accurate light and loaded weight of three locomotives, which must be obtained in the following manner:

(LIGHT WEIGHT METHOD)

The entire locomotive must be placed on scales, the boiler and sand boxes being empty, and without crew. The locomotive must otherwise be fully equipped for service including firebrick or allowance for weight thereof, namely, 5065 lbs. for firebrick and 700 lbs. for mortar, a total of 5765 lbs.

(LOADED WEIGHT METHOD)

In obtaining loaded weights of locomotives the following method, must be followed:

1. There must be 9-1/2" of water above the highest point of crown sheet which corresponds with three gauges of water.
2. Steam in boiler must be up to full boiler pressure.
3. All connecting rods must be applied and locomotive otherwise fully equipped for service, including firebrick or allowance for weight thereof, namely, 5065 lbs. for firebrick, and 700 lbs. for mortar, a total of 5765 lbs.
4. Sanddome must be entirely filled, or allowance made for the weight of sand, namely 2500 lbs.

Sand box in cab must also be filled or allowance made for weight of sand.

5. Driving boxes must be perfectly free between shoes and wedges so that equalizers and springs may evenly distribute weights.
6. Two men, 175 pounds each, in cab, or their equivalent in weight, 350 pounds, should be added.
7. In placing the locomotive on scales to obtain the separate weights on drivers and trucks, locomotive must be placed so that the end of scales will be midway between centers of nearest drivers and truck axles. Care should be taken to see that crank pins are in relatively central position; that is, one crank pin should be at an angle of 45° forward of the vertical center of axle, and the other crank pin 45° back of the vertical center of axle.
8. The entire locomotive should be placed on scales to obtain the total weight.

WEIGHTS OF PARTS

Builder must furnish scale weights of various parts, such as axles, bearings, boiler (tubed), boiler (without tubes), boxes, cab (assembled), connecting rods, crosshead, engine bed, guides, mud ring, pedestal cap, pilot, piston, piston rod, skyline casing, smoke box front, smoke lifter, smoke stack, springs, spring rigging, steam turrets, tires, trucks,

wheel centers and wheels (separate and mounted) and other parts as may be requested by Railroad Company.

TRACTIVE POWER

Tractive power without Booster (M.E.P. considered as 83 percent of boiler pressure and nominal tire diameter of 80")........................64,760 lbs.

Tractive Power with Booster (Approx.)....79,660 "

HEATING SURFACE

Flues, 3-1/2" dia........................	3,885	Sq.Ft.
Tubes, 2-1/4" dia........................	617	" "
Fire Box.................................	388	" "
Evaporating..............................	4,890	" "
Superheater..............................	2,565	" "
Combined.................................	7,455	" "
Grate area...............................	90.4	" "

RATIOS

Combined H.S. to cylinder volume........	294.1
Adhesive weight of combined H.S.	37.02
Adhesive weight to tractive effort......	4.26
Tractive effort to adhesive weight......	.235
Adhesive weight to total weight.........	.588
Combined H.S. to tractive effort........	.115
Total weight to combined H.S.	62.91
Combined H.S. to grate area.............	82.5
Firebox H.S. in % of evap. H.S..........	7.87
Superheater H.S. in % of evap. H.S.	52.5

CENTERS OF GRAVITY

Builder must furnish Railroad Company with horizontal and vertical centers of gravity for both light and loaded engine.

CURVATURE

Each locomotive must be tested out on an 18° curve before leaving builders' plant.

GENERAL SPECIFICATIONS

REFERENCES

Material Specifications, Specialty Specifications and Schedules are bound under separate cover.

For Specifications for Common Standard 23,500 gallon Rectangular Tenders, Class 235-R-1, including painting, lettering and numbering of locomotive and tender, see Specification CSL-1051.

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CASTINGS AND FORGINGS

All castings must carry in raised letters and figures the Railroad Company pattern classification, if indicated on drawings. Forgings to be stamped with classification and number, only if so indicated on drawing. New forging numbers to be assigned and stamped on parts which were castings on previous locomotives and are now forgings.

Railroad Company's pattern numbers and forgings bear the following prefix to designate materials, as follows:

LA - for cast aluminum
LB - for cast brass
LF - for locomotive forgings
LI - for cast iron
LM - for cast malleable iron
LS - for cast steel

Railroad Company will furnish Builder with block of numbers, for new patterns and forgings differing from those shown on Railroad Company's drawings, upon receipt of request from Builder.

CASTINGS, BRASS AND BRONZE

All brass and bronze engine truck, driving, and trailing truck journal bearings, connecting rod bearings, and pedestal shoes and wedges must be furnished by the Magnus Company unless otherwise specified.

DELIVERY

This specification calls for locomotives finished and completed in every respect and ready for service delivered on the line of the. ....

......................at..............................

DRAWINGS AND SPECIFICATIONS

All drawings mentioned in the alphabetical index bound in this specification, together with any other drawings and separate specifications furnished by the Railroad Company, form a part of this specification. They must be regarded as a whole, and parts referred to in one and not in the other must be considered as appearing in both.

ENGINE BOLTS

Engine bolts, where specified, to be made of MAYARI engine bolt steel or alternate nickel steel, SAE 2115.

INSPECTION

The Railroad Company reserves the right to place as many inspectors as may be deemed necessary at the Builder's works, who are to have free access at all times to all drawings and work, that they may see that the provisions of the specification are complied with in every respect. Any material or details which do not conform to the specifications will be rejected and must be replaced by the builder.

[illegible]

All brass and bronze engine truck, driving, and trailing truck journal bearings, connecting rod bearings; and [illegible] shoes and wedges must be furnished by the [illegible] Company unless otherwise specified.

DELIVERY

This specification calls for locomotives finished and completed in every respect and ready for service delivered on the line of the ....

....

DRAWINGS AND SPECIFICATIONS

All drawings mentioned in the alphabetical index bound in this specification, together with any other drawings and separate specifications furnished by the Railroad Company, form a part of this specification. They must be regarded as a whole, and parts referred to in one and not in the other must be considered as appearing in both.

ENGINE BOLTS

Engine bolts, where specified, to be made of [illegible] engine bolt steel or alternate nickel steel. SAE #1115;

INSPECTION

The Railroad Company reserves the right to place as many inspectors as may be deemed necessary at the Builder's works, who are to have free access at all times to all drawings and work, so that they may see that the provisions of the specifications are complied with in every respect. Any material or details which do not conform to the specifications will be rejected and must be replaced by the Builder.

Engines are not to be painted or given running test until all defects in workmanship or material reported by Railroad Company's inspectors are corrected, unless otherwise authorized by inspectors.

Locomotive builder must furnish and issue to Railroad Company's inspectors copies of all drawings or sketches issued to their shops for inspectors' information in checking work and material. Builders to direct inspectors' attention to all drawings issued showing authorized changes or deviations from Railroad Company's specifications and drawings.

Railroad Company's inspectors must be furnished with copy of any rejection made by builder's own inspectors at time rejection is made.

For inspectors' information, any material that is found to be unsatisfactory or fails to meet requirements of specification during course of construction should be held for examination by Railroad Company's inspectors.

I.C.C. REQUIREMENTS

Locomotives must in all respects meet with the requirements of the Orders of the Interstate Commerce Commission. Builder must furnish Railroad Company with copy of all calculations made in determining stresses shown on Specification Card for boiler.

KEYS AND STEEL TAPER PINS

Flat keys and steel taper pins, as shown on drawings, must be applied where indicated, and must be made to pinch nuts wherever practicable.

MARKING AXLES, ETC.

All axles, connecting rods, crank pins, domes, driving box shoes and wedges, driving and trailing wheel tires, engine truck wheels, pedestal caps, piston rods, etc., must be stamped as shown on drawing.

MARKING SPRINGS

Elliptic, semi-elliptic and coil springs must be stamped by spring maker with the name or trademark of the manufacturer and date made, and locomotive builder must stamp on elliptic and semi-elliptic springs the date of application, as shown on drawing.

MATERIAL AND WORKMANSHIP

All material and workmanship must be of the best quality and work accurately fitted to gages and templates to insure thorough interchangeability, and must be satisfactory to Railroad Company's inspectors.

MATERIAL INDEX

Builder must furnish bound index of all material used in the construction of locomotives.

NUMBERING WHEELS

Truck wheels must be stamped in accordance with instructions from General Superintendent Motive Power.

PATENTS

The Builder must guarantee the Railroad Company against loss through suits, royalties, or claims of any kind whatsoever on patented articles or material furnished by the Builder.

PHOTOGRAPHS

Builder must furnish the Railroad Company's General Superintendent of Motive Power six copies each of photographs of one locomotive, taken of the following views: Left broadside, right broadside, head-end front view, and three of interior of cab.

Size of photographs to be approximately 8"x10".

PIPE BUSHINGS

Use of pipe bushings is not permissible.

PIPE FITTINGS

All pipe fittings must be A.A.R. standard for 300 lbs. pressure, unless otherwise specified.

RIVETING, GENERAL

All riveting must be done thoroughly and in a workmanlike manner in every respect. Rivets must be centrally headed and tightly driven, entirely filling holes, which must be perfectly true before rivet is inserted.

RUNNING TEST

After locomotive is ready for service and all defects have been repaired to the satisfaction of the Railroad Company's inspectors, running test of not less than 3 hours' duration must be made, to wear in bearings.

SCREW THREADS BOLT HEADS AND NUTS

All screw threads, bolt heads and nuts must conform to the United States' Standard (A.A.R.) except holes tapped in boiler, or otherwise shown on drawings.

STEPS, LADDERS, HANDHOLDS AND GRAB IRONS

All bolts and studs supporting steps, ladders, handholds and grab irons, must be riveted over sufficiently on ends to prevent nuts from working off.

TRACINGS, PRINTS, AND INDEX OF DRAWINGS

The Builder must furnish Railroad Company with tracings conforming to sizes shown on Drawing BM-500-E of all new drawings made, including piping arrangements, specialty drawings, and erecting diagrams, which differ from Railroad Company's draw-

ings. Any tracings so furnished may be mechanically made, but all reproduced tracings must be of such quality that surfaces will not crack, peel, or adhere to other tracings. In all cases where only minor changes have been made from Railroad Company's drawings, the Builder must furnish marked prints to show changes made.

Builder must also furnish prints of all drawings used which are the same as Railroad Company's drawings as well as a complete index of all drawings used in the construction of the locomotives.

Free and loaded heights must be shown on all spring drawings.

Tracings must be furnished Railroad Company of all drawings covering bearings and springs differing from those shown on Railroad Company's drawings, prior to receipt of the first locomotive at point of delivery on Railroad Company's line. All other tracings and marked prints must be furnished as soon as possible, but not later than two (2) months after completion of first locomotive.

UNIONS

A.A.R. 300-pound air furnace malleable iron Corley unions and union fittings must be applied, except where otherwise specified.

WASHERS,
HI-POWER
SPRING
GENERAL

Improved Hi-Power spring washers manufactured by the National Lock Washer Company must be applied under nuts of bolts or studs securing brackets, supports, clamps, etc., that are liable to work loose from vibration. All as shown on drawings.

WELDING, GENERAL

All surfaces to be welded, together with filling material, must be clean and kept free from grease, rust, scale and other foreign matter, and the weld made on clean, bright metal. Coated welding rods of proper size and quality must be used. All efforts should be made to reduce oxidation to a minimum and have all metal thoroughly fused and flowed together so as to form a homogeneous whole, free from burned metal, porosity and slag. The scale and oxide coating of deposited filler metal should be removed from each layer before the new layer of welding is applied.

The welding of studs, nipples and pipe connections to barrel of boiler, to wrapper or side sheets, is prohibited. This shall not prohibit the welding of studs to sides and bottom of mud ring.

Removing broken studs from any part of the boiler by use of the acetylene torch is prohibited. Use of acetylene torch is prohibited for cutting holes in boiler shell or liners for any purposes whatsoever.

Builder must satisfy Railroad Company's inspectors that only qualified welders are to be permitted to do welding on boilers.

Any welding other than that indicated on drawings or shown in specification, is not to be done without first being authorized by Railroad Company's inspectors.

SPECIFICATIONS FOR MATERIAL

The following specifications for material form a part of this Specification, viz:

C.S. 78-B - Bars, Carbon Steel Hot Rolled.

A.A.R.Spec.M-302-37 - Bars, Wrought Iron, Refined..

C.S. 12-G - Bearing Metal, Babbitt, Bell Metal, Brass Castings and Bronze Castings.

C.S. 77-A - Blooms, Billets and Slabs for Forgings, Carbon Steel.

A.A.R.Spec.M-307-34 - Blooms and Forgings, Wrought Iron.

A.A.R.Spec.M-402-34 - Castings, Malleable Iron.

A.A.R.Spec.M-201-36 - Castings, Steel.

A.A.R.Spec.M-301-37 - Chain, Iron and Steel.

A.A.R.Spec.M-204-35 - Couplers, A.A.R. Type "E".

C.S. 2-C - Forging Steel, and Blooms for same (Normalized and drawn).

A.A.R.Spec.M-104-37 - Forging Steel, and Blooms for same (Normalized and Tempered).

A.A.R.Spec.M-102-34 - Forging Steel, and Blooms for same. (Annealed and Unannealed).

A.A.R.Spec.M-602-38 - Gaskets, Air Brake Hose.

A.A.R.Spec.M-601-38 - Hose, Air Brake and Train Signal.

A.A.R. Spec.M-605-38 - Hose, Steam and Hot Water.

A.A.R.Spec.M-606-38 - Hose, Tender Tank.

A.A.R.Spec.M-117-37	- Jacket Steel, Locomotive Boiler.
S.P. 111-N	- Journal Box Oil.
C.S. 27	- Lead, Ingot.
A.A.R.Spec.M-118-36	- Pins, Coupler Knuckle Pivot, etc.
C.S. 16-A	- Pipe, Copper and Brass.
A.A.R.Spec.M-306-38	- Pipe, Black and Galvanized Steam, Gas & Water.
A.A.R.Spec.M-111-36	- Pipe, Welded and Seamless Steel.
International Nickel Company's Railroad Spec. No. 3	- Low Carbon Nickel Steel Boiler Shell and Inside Firebox Plates.
A.A.R.Spec.M-110-36	- Rivet Steel, and Rivets for Boilers.
A.A.R.Spec.M-109-36	- Rivet Steel, Structural and Structural Rivets.
A.A.R.Spec.M-116-37	- Shapes and Plates, Structural Steel.
C.S. 17-D	- Spring Steel and Elliptical and Coil Springs.
A.S.T.M.Spec.A-59-27	- Springs, Engine Truck.
A.A.R.Spec.M-305-36	- Staybolt Iron.
C.S. 35	- Tin, Ingot.
A.A.R.Spec.M-106-34	- Tires, Steel.
A.A;R.Spec.M-108-37	- Tubes, Boiler, Superheater, etc., Locomotive.
A.A.R.Spec.M-404-34	- Unions and Pipe Fittings, 300-lbs. Pressure.
C.S. 10-E	- Waste, Colored Cotton and Wool.
A.A.R.Spec.M-107-37	- Wheels, Multiple Wear, Solid Wrought Steel, (Quenched and Tempered).

Material Specification Numbers referred to above must be followed, irrespective of what Specification Number is referred to on drawings.

LIST OF ARTICLES TO BE FURNISHED BY THE RAILROAD COMPANY SHOWING DRAWING, SCHEDULE OR SPECIALTY SPECIFICATION NUMBERS

LOCOMOTIVE CLASS GS-4

-A-

Air Brake Equipment......................See Specialty Spec. L-191

Axles: (to be furnished rough turned with hollow bore finish bored after heat treatment)

  Driving (12" x 14")................See Drawing AL-18214-B
  " (13" x 14")................ " " AL-18215-B
  Engine Truck...................... " " AL-17359-B
  Trailing Truck, Front (7" x 14").. " " BL-15876-A
  Trailing Truck, Rear (9" x 14").. " " AL-15877-A

-B-

Back Pressure Gauge:

  Ashcroft - Type 1043..............See Drawing CL-17963-C
  Ashton - Type 62BPA............. " " BL-15084-C

Bearings, Axle - Magnus Company, Inc.:

  Driving.............................See Drawing BL-16481-M
  Engine Truck (Self-Cooling Oil Tube Type)..................See Drawing CL-18049-B
  Trailing Truck (Self-Cooling Oil Tube Type)..................See Drawing CL-18049-B

Bell Ringer:

  Transportation Devices Corporation......................See Drawing CL-18867

Boiler Drop Plugs - Nathan Mfg.Company...See Drawing AL-18639

Boiler Tubes and Superheater Flues.......See Drawing CL-13792-I

Booster Engine - Franklin Railway Supply Co.- Type C-2 Equipment, Complete (50% cut-off)	See Drawing	SL-17670) SL-17671)
Brake Shoes:		
Driver	" "	BL-16711-C
Engine Truck	" "	BL-16813
Trailing Truck	" "	BL-16710-C
Buffer, Radial (Spring Type E-2) Franklin Ry. Supply Co. ~~(with oil lubrication)~~ (Wearing faces on stationary and adjustable buffer to be hardened; (floating chafing block not to be (hardened).	" "	DL-18082-A (Modify to suit)

-C-

Conduit & Fittings, Electric (Bill of Material)	See Drawing	BL-18250A
Conduits:		
3/4" Sleeve Joint (Franklin)	See Drawing	DL-18044C
2" " " "	" "	DL-18043B
2-1/2" " " "	" "	DL-18035A
Coupler - A.A.R. Type "E"	" "	AL-16702B
Crank Pins - Main (to be furnished rough turned with hollow bore finish bored after heat treatment)	See Drawing	BL-17367D
Cylinder Cocks, Air-Operated (To be applied at destination: one set (to be furnished builder for testing (locomotives)	" "	20224-D, Book 675

-D-

Dial Thermometer, American Schaeffer & Budenberg Div. of Consolidated Ashcroft Hancock Co. Inc. (Type 603 RB)	See Ashcroft Bulletin 177.	
Draw Casting, Front	See Drawing	AL-17477D

-E-

Engine Truck (Complete)....................See drawing DL-17809-B

-F-

Feedwater Equipment (Injector, Cushion -
type check valve for FWH, etc.)....... " " BL-19330-

Feedwater Heater (Type 5-1/2 S.A.):

Heater............................. " " BL-18006

Hot Pump........................... " " BL-17286

Centrifugal Cold Pump............... " " AL-17285-A

-H-

Headlight Case (Pyle National)................See Drawing CL-17011-B

Headlight Equipment - Turbo Generator.......See Page 61

Horn, Tyfon Air (Including Operating
Valve, Relay Valve, & Self-Cleaning
Strainer)
Leslie Co. Type A-200-L................See Drawing BL-17002

Hose, Tank 4-1/2"...........................See Drawing AL-12172-Q

-J-

Journal Box Lids, Trailing-Truck
(Symington)............................ " " CL-18226-A

-J-

Journal Lubricators: (Southern Pacific Company)

Driving Box..............................See Drawing DL-18247-C

Engine Truck.......................... " " DL-18247-C

Trailing Truck........................ " " DL-18247-C

-L-

Lubricators, Mechanical:

Detroit - 8-Feed, Model "A", 24 pint capacity....................See Detroit Lubricator Co'sBulletin #19

Nathan - 8-Feed, Type DV-4, 20 pint capacity...................See Drawing SL-17751-A

Nathan - 14-Feed, Type DV-7, 36 pint capacity.................. " " DL-18467-A

-O-

Oil Distributors - Four-Way: (Nathan #3515).See Drawing CL-18470

-P-

Packing:

Piston Rod, 5-1/4"...................See Drawing CL-15824-C

Valve Rod, 2"......................... " " CL- 1698-L

Power Reverse Gear (Alco Type "G", equipped for Alemite lubrication)........... " " CL-18379

-S-

Safety Valves:

2" Ashton..............................See Drawing AL-18251-B

-S-

Safety Valves:

2" Consolidated..........................See Drawing CL-13715-E

3-1/2" Ashton........................... " " CL-16522

3-1/2" Consolidated..................... " " CL-13163-E

Sander:

Viloco (Single Unit Reversible Type FL-317)
See Drawing CL-16941-B

Sander Operating Valve #281 (Viloco)......... " " DL-15304-C

Signal Foam Meter, Model "GES"............... " " DL-18205-A
(Electro-Chemical Engineering Corp.)

Smoke Box Front Hinges, Okadee:

Application............................. " " CL-17748

Butts................................... " " CL-16162-A

Pins and Bolt........................... " " AL-15341-F

Straps.................................. " " CL-17749

Speed and Cut-Off Indicator:

Locomotive Valve Pilot Model VP-120:

Flexible Shaft & Connections - Similar to Drawing BL-16942

Instrument Assembly " " " DL-16943

Friction Drive Assembly " " " CL-16944

Cam Case Assembly " " " DL-16945

Adjustable Lever Post Assembly " " " AL-16946

Operating Rod & Turnbuckle
Assembly " " " AL-16947

Springs, Half Elliptic: (to be furnished by Locomotive Builder)

Staybolts, Telltale Flexible F.B.C........See Drawing CL-16733-F

Steam Gage: (Graduated 0-500 lbs.)

Ashcroft...........................See Ashcroft American
Bulletin #155

Ashton.............................See Drawing AL-16580-E

Crosby............................. " " AL-15325-C

Steam Heat Gage:

Ashcroft........................... " " AL-18248

Ashton............................. " " AL-16581-B

Steam Heat Reducing Valve:

Leslie.............................See Specialty Spec.
L-162-D

Vapor Car Heating Company (#239)...See Drawing DL-16929-A

Stop Valve, Locomotive (#210)........... " " CL-16930-B

Superheated Steam Pyrometer (Model 496).. " Specialty Spec.L-195

Superheater Equipment - The Superheater Co. See " " L-195

-T-

Tangential Steam Dryer - American Throttle
Company..........See Specialty Spec.L-195

Tank Level Indicator -Ashcroft American See Ashcroft American
Type 1189-T.........Bulletin 175-A

Throttle - American Throttle Co.	See	Specialty Spec.	L-195
Tire Retaining Clips - Southern Pacific Co.	"	Drawing	BL-18116-C
Tires, Driving and Trailing Wheels	"	"	AL-13294-W
Trailing Truck: (Four Wheel Delta Type).			
Centering Device	See	Drawing	CL-18278-A
Frame (modified to suit coil spring on equalizer system)	"	"	SL-17072-B

-W-

Water Gage - Nathan Wiltbonco Type "BXA" No. 5 (To be furnished without stems)	See	Drawing	BL-17218-B
Wheels, Engine Truck:			
Wrought Steel	See	Drawing	AL-17360-B
Whistle Cab Valve, Pneumatic:			
Viloco Railway Equipment Co. (for steam whistle)	"	"	CL-17559-C
Wrenches, (Drop Forged Steel)	"	"	BL-18306-A
Wrenches, (Packing Hook and Packing Iron)	"	"	AL-18309

NOTE:

Where more than one type of same specialty is referred to above, the Railroad Company will specify the type to be furnished.

The material mentioned in the Specialty Specifications or drawings referred to above will be furnished by the Railroad Company to be applied by the builder, and such material not mentioned and which is necessary for the application of the different parts furnished, must be furnished by builder. For list of paints to be furnished, see Material Specifications.

DETAIL SPECIFICATIONS

BOILER

BOILER, GENERAL

Type	Conical, Radial Stayed with sloping back head
Fuel	Oil
Working steam pressure	300 lbs. per sq. in.
Diameter, first course, outside	86"
Firebox, length	127-1/8"
Firebox, width	102-1/4"
Combustion chamber, length	80"
Water space at mud ring, front	5-1/2"
Water space width at mud ring, back and sides	5"
Tubes, number and diameter	49 - 2-1/4" O.D.
Flues, number and diameter	98 - 3-1/2" O.D.
Length over flue sheets	21' 6"
Heating surfaces and grate area	See Page 5

Thickness of sheets to be as follows:

Smoke Box Sheet	5/8"	Front Tube Sheet	5/8"
First course shell	7/8"	Second course shell	15/16"
Third course shell	31/32"	Back Tube Sheet	1/2"
Inside throat sheet	1/2"	Outside throat sheet	7/8"
Back head	1/2"	Door sheet	3/8"

Roof Sheet	3/4"
Outside side sheets	1/2"
Inside crown and side sheets	3/8"
Combustion chamber sheet	3/8"

IMPORTANT: Design and construction of boiler must be such as to provide for a minimum factor of safety of 4.5 in the completed boiler.

BOILER SHEETS, MATERIAL OF

All boiler and firebox sheets, together with liners and welt plates, must be made of nickel steel in accordance with International Nickel Company's Railroad Specification No. 3 entitled "LOW CARBON NICKEL STEEL BOILER SHELL AND INSIDE FIREBOX PLATES."

All flanged boiler sheets to be thoroughly annealed after flanging.

Smokebox Sheets and liners to be Structural Steel plate in accordance with A.A.R. Specification M-116, latest revision.

BOILER, TESTING OF

Builder must furnish the Railroad Company's General Superintendent Motive Power a complete record of each boiler covering the results of tests, both chemical and physical, of all boiler and firebox sheets, including Domer Liner, Welt Plates, Dome, etc., together with the maker's name and serial number; also their respective location in the boiler. Boiler num-

ber must be referred to in furnishing this information. Copies must be furnished to Railroad Company's Chief Inspector at time boiler is sent to Erecting Shop. Slab, heat and serial number must be applied to each plate.

Boiler must be made perfectly tight under the following tests and a record of the same must be sent to General Superintendent of Motive Power:

WATER TEST: All seams, rivets, tubes, joints, etc., must be made perfectly tight under a hydrostatic pressure of 375 lbs. per sq. in., 25% in excess of the working boiler pressure. Flexible staybolts must be tested for tightness under hydrostatic pressure of 375-lbs. per sq. in., and hammer tested at 300-lbs. hydrostatic pressure.

Boiler must be filled with clean water and Boiler Drop Plugs must be applied before boiler is given either hydrostatic or steam test.

STEAM TEST: Boiler must be fired up to a steam pressure of 330-lbs. per sq, in., 10% in excess of the working boiler pressure under which pressure the boiler must be made perfectly tight. The pressure must be reduced twice to 50% of ber must be referred to in furnishing this information. Copies must be furnished to Railroad Company's Chief Inspector at time boiler is sent to Erecting Shop. Slab, heat and serial number must be applied to each plate.

Boiler must be made perfectly tight under the following tests and a record of the same must be sent to General Superintendent of Motive Power:

HYDRO TEST: All seams, rivets, tubes, joints, etc., must be made perfectly tight under a hydrostatic pressure of 275 lbs. per sq. in., 25% in excess of the working boiler pressure. Flexible staybolts must be tested for tightness under hydrostatic pressure of 25-lbs. per sq. in., and hammer tested at 300-lbs. hydrostatic pressure.

Boiler must be filled with clean water and boiler drop plugs must be applied before boiler is given either hydrostatic or steam test.

STEAM TEST: Boiler must be fired up to a steam pressure of 250-lbs. per sq. in., 10% in excess of the working boiler pressure under which pressure the boiler must be made perfectly tight. The pressure must be repeated three or four times.

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working boiler pressure and raised to 10% in excess of the working boiler pressure.

Boiler must be made perfectly tight under this raising and lowering of pressures.

The above tests must be made before the lagging and jacket are applied.

After all steam joints are made, and all piping, and lagging and jacket applied, the boiler must be fired up a second time, steam raised to working pressure, and all steam joints tested and made perfectly tight under pressure.

BLOW-OFF COCK HOLE REINFORCEMENTS

Boiler side sheets must be reinforced with inside liner 3/8" thick at blow-off cock holes.

BOILER DROP PLUGS

Five (5) Boiler Drop Plugs, Size No. 1, as shown on drawing furnished, must be applied in the crownsheet of the combustion chamber in locations shown on boiler drawings, namely:

1. One (1) Boiler Drop Plug to be located on longitudinal centerline of crownsheet between the first and second transverse rows of radial staybolts counted back from the firebox tube sheet.
2. One (1) Boiler Drop Plug to be located between the seventh and eighth transverse rows of radial

staybolts counted back from the firebox tube sheet.

3. Two (2) Boiler Drop Plugs to be located between the eleventh and twelfth transverse rows of radial staybolts counted back from the firebox tube sheet; one right and one left of the longitudinal centerline of the crownsheet between the third and fourth longitudinal rows of crown stays counted from the centerline of the crownsheet.
4. One (1) Boiler Drop Plug to be located on longitudinal centerline of crownsheet between the fifteenth and sixteenth transverse rows of radial staybolts counted back from the firebox tube sheet.

BRACKETS, ETC.

In case any brackets, etc., are secured to any part of boiler where they cover hollow staybolts, holes 1-1/4" diameter must be drilled through part covering hollow staybolts directly over center of hole in each staybolt.

DOME AND SHUT-OFF VALVE

One piece type dome 36" I.D. must be of firebox quality steel to dimensions shown on drawing and riveted to boiler with full head rivets. A dome shut-off valve provided with stainless steel stem having outside thread and cast stainless steel bonnet must be applied to dry pipe as shown on drawing.

DRY PIPE AND RING

Dry pipe must be standard weight seamless steel pipe 10" O.D., 5/16" thick, in accordance with A.A.R. Specification M-111, latest revision, and drawing

furnished. Dry pipe sleeves to be of forged steel, finished all over, as shown on drawing, pressed on and welded to dry pipe.

Dry pipe ring to be of forged steel in accordance with A.A.R. Specification M-102, latest revision, Grade 2, and secured to front flue sheet by a continuous steam-tight weld on the inner circumference of the ring where it contacts the flue sheet and by intermittent welds equally spaced between stud holes around the outer circumference of the ring. All as shown on drawing.

FINISH AND LAGGING

Boiler must be lagged with 85% magnesia boiler covering jacketed with locomotive boiler jacket steel No.18 U.S. standard gage in accordance with A.A.R. Specification M-117, latest revision, cold rolled sheets, 48" and 60" wide, and 120" long, secured by bands of the same material.

Lagging and jacket to be removable over short stays. Backhead to be lagged to deck. Sides of firebox below running boards not to be lagged. Throat not to be lagged. Jacket must be painted as specified.

A removable cover plate must be placed over dome, which may be removed independently of skyline casing for dome inspection and repair.

Lagging corner finish and support on each side of firebox must be in one piece and applied in a neat manner.

Railroad Company's standard sizes of lagging as shown on drawing to be used as far as practicable.

FIRE DOOR

Fire door, as shown on drawing, must be of cast steel and applied in accordance with drawings furnished.

FIRE PAN AND FIRE BRICK

Firepan to be of the welded round bottom type made of 3/8" steel plates reinforced by angles in manner shown on drawing. Pan to be welded throughout unless otherwise indicated on drawing and all parts to be welded must be free from scale and sand. Plates to have continuous welds; angles to have intermittent welds. Pan must be supported from mud ring by 7/8" studs, tapped 1-1/8" deep in bottom of ring. Unarco double seal firepan tape 3" and 5" wide and 1/4" thick must be applied between pan and mud ring, and No.20 refractory cement to be applied around all firepan joints. All joints between pan and surrounding parts to be absolutely air tight.

Draft openings to be provided in firepan in locations shown on drawing. Combined air openings around oil burner and through firepan must be equal to 30% of the total gas area of tubes and flues. Side openings in firepan to be equipped with counterweighted hinged damper doors operating in steel chutes as shown on drawings. Draft opening on bottom centerline at rear of firepan to be controlled by chain type

damper regulator on fireman's side of cab. Openings in firepan to be reinforced by cast iron rings as shown on drawing.

Firebrick will be furnished and applied by the Railroad Company at destination.

FURNACE BEARER SHEETS

Front and rear furnace bearers must be of 3/4" open hearth steel plate accurately fitted to mud ring lugs and rear bed section by 1" and 1-1/8" turned bolts, respectively. 5/8" strips of steel must be riveted to top and bottom of sheets with 3/4" rivets to provide proper amount of bearing for bolts. Sharp edges on plates must be removed.

MUD RING

Mud ring must be made of open hearth cast steel, annealed, machined inside and outside and double riveted, as shown on drawing. Mud ring must extend 3/8" below sheets to permit caulking.

RIVETED JOINTS AND RIVETING

Longitudinal seams in barrel of boiler must be butt joint, sextuple riveted, welded on both ends and as shown on drawing. The weld is not to be considered in determining strength of seams.

The dome reinforcements on dome course must provide strength equivalent to that of the longitudinal section of plate comprising this course.

Circumferential seams of barrel and throat sheets must be double riveted lap joints, as shown on boiler drawing.

All rivets must be of steel in accordance with A.A.R. Specification M-110, latest revision.

All rivet holes must be 1/16" larger than diameter of rivets and must be drilled and reamed perfectly true with each other before rivets are inserted. Holes to be reamed after sheets have been drawn together tightly by bolts placed in every other drilled hole. Drifting of rivet holes will not be allowed. Rivet holes to have 1/16" radius at edges of holes adjacent to rivet heads.

Butt straps and welt straps must be removed and all lubricants and cuttings cleaned off before any riveting is done.

All seams of boiler shell and firebox must be properly caulked inside and outside with round nose caulking tool. Sharp edged caulking tools must not be used under any circumstances.

Rivets to be hot pressed, and driven hydraulically whenever possible. All rivets must have full formed concentric heads.

Where hand riveting is necessary, the rivet must be backed up with a solid tool. The use of a riveting gun for this purpose will not be permitted.

Hydraulic riveting machines must be arranged so as to insure automatic control of the pressure on the die in order to obtain adequate cooling of

the rivet before the pressure is released, and must also be equipped with gauge and timing device to insure full pressure on the rivet for the required length of time.

The following pressures and driving periods, according to rivet size, must be used:

Size of Rivet (Diameter)	Driving Pressures (Tons)	Driving Period (Seconds)
7/8"	70-85	8
1"	80-100	10
1-1/8"	100-125	10
1-1/4"	130-150	12
1-3/8"	150-165	14
1-1/2"	165-175	14

SMOKEBOX

Smokebox to be made of 5/8" steel plate reinforced over cylinder saddle with 5/8" steel plate liner secured to smoke box by 7/8" rivets. Edges of smoke box sheet and liner at cylinder opening must be seal welded. Smoke box front and door to be of 1/2" pressed steel plate as shown on drawing. Surfaces between front and door must be finished smooth to form an air tight joint. Door clamps to be made of drop forged steel.

Smoke box front to be secured to smoke box by Okadee hinges applied as shown on drawing. Cored holes in hinges must be made small enough to permit finishing to size shown on drawing.

Smoke box ring must be secured to smoke box by 64 - 7/8" diameter rivets, equally spaced. Smoke

box front to be secured to ring by 64 - 7/8" diameter studs with U.S. Form threads tapered 3/4" in 12", located as shown on drawings. Studs securing smoke box front to be equipped with Hi-Power spring washers. Unarco smokebox gasket, Style 740, graphited on one side, or equivalent Johns-Manville, to be applied between smokebox front and ring.

SPARK ARRESTER

Spark Arrester made up of 3/16" steel plates, angles and W.S.Tyler Company's #363 DRAFTAC wire screen, or equivalent manufactured by Roebling, must be applied to inside of smokebox as shown on drawing. Table plate must be of steel plate construction. All as shown on drawings. Type of netting to be used will be specified in order and builder must be governed accordingly.

When making holes in spark arrester netting for bolts, studs, etc., drift pin should be used to force the strands apart to size of hole required, thus avoiding the use of a punch and cutting the strands. Strands should not be heated.

STACK

Smoke stack, smoke stack base, and inside tapered extension must be made of cast steel, cast integral as shown on drawing. Inside straight extension to be made of cast iron. Extension to be secured to stack by 7/8" square head bolts of Mayari steel or alternate nickel steel, SAE-2115. Nuts on

these bolts to be secured with cotter pins. Base of stack to be bevel-welded to outside of smokebox to provide an air tight joint; all as shown on drawing.

STAYBOLTS

General: Holes for all staybolts and crown stays must be drilled sufficiently small to insure a smooth hole for a perfect thread. Holes for staybolts in crown and sides exclusive of those in the sharp bends to be 1/4" less than staybolt size. Holes for staybolts in the sharp bends of the crown sheet to be 7/16" less than staybolt size. Sharp crown sheet bends to be formed by a sufficient number of passes through rolls so as not to set up undue stresses in plate between drilled holes.

All staybolts except hollow flexible and crown staybolts to extend not more than 1/4" through sheet for riveting and to be cut off square before riveting. Hollow flexible and crown staybolts to extend 3/8" through firebox sheets for riveting.

In riveting up all staybolts, special care must be taken to leave uniform and sufficient heads on all bolts.

All staybolt material must be manufactured

by either of the following concerns:

"ULSTER" - Ulster Iron Works, Dover, N.J.
"EWALD" - Ewald Iron Co., Louisville, Ky.

Rigid Staybolts: All rigid water space staybolts to be 1" diameter, 12 threads per inch, Whitworth Form with body reduced to diameter of bolt at bottom of thread.

Solid rigid staybolts to have 7/32" diameter hole drilled 1-1/4" deep from outer end exactly in the center.

Hollow rigid staybolts to be applied where shown on drawing and must have a 7/32" diameter drilled hole exactly in the center and extending the entire length of the staybolt.

Rigid crown and radial staybolts to have 1" diameter body; lower end of bolt must have tapered threads, Whitworth Form, 1-5/32" diameter at top of thread tapered to 1-11/32" at bottom of thread, taper to be 1-1/2" in 12". Upper end of bolt must have 1-1/8" diameter straight thread, Whitworth Form. All as shown on drawing.

Special care must be taken when applying crown staybolts to insure against stripped thread on tapered end. Staybolts must be backed out where necessary and re-entered to

insure that threads are not crossed.

Flexible Staybolts

Hollow flexible staybolts to be applied where indicated on drawings. All flexible staybolts to be of the ball-headed telltale type of approved design having 1" diameter body and straight threads, 12 per inch, Whitworth Form, and with 7/32" diameter telltale hole. Sleeves for flexible bolts to be welded on; maximum diameter of reamed holes in boiler for flexible staybolt sleeves to be 1-3/8".

Graphite and cylinder oil mixed thin must be applied to threads of caps when screwed in place to insure easy removal when necessary for inspection.

All flexible staybolts must be released slightly from close contact with sleeve seat before riveting up, in order to reduce tendency of riveting operation to shorten bolts. While bolts are being riveted, the "holder-on" must be held securely against head of bolt directly in line of riveting blow.

STEAM AND EXHAUST PIPES

Steam pipes in smokebox to be cast steel, 8" inside diameter, of the outside connected type as shown on drawing provided with bosses for pyrometer, back pressure gauge, and oil spud. Reid steam pipe cas-

ings to be applied as shown on drawing. Steam pipes must be subjected to hydrostatic pressure of 100-lbs. per sq. in. after being erected.

All steam and exhaust pipe castings must be inspected at Builder's works to be sure that walls are of uniform thickness and in accordance with drawings.

Steam piping to feedwater heater pumps, air compressors, turbo-generators and power reverse gear must be extra strong wrought iron pipe with A.A.R. 300 lb.fittings. Piping to be applied under boiler lagging.

All steam pipes in cab to be extra strong wrought iron pipe with A.A.R.300 lb.fittings, except when otherwise specified. Steam pipes must not be fastened to cab.

All flange connections in pressure piping to have ball joint rings. No gasket to be used. All screw pipe flanges to be steel.

All joints to be steam tight under steam test.

All piping must be applied so flexible and rigid staybolts can be readily removed. Pipe must not pass over either staybolts or washout plugs.

STUDS

All studs in boiler shell must have 12 U.S. Form threads per inch, tapered 3/4" in 12", and must be screwed in until perfectly tight.

SUPERHEATER AND THROTTLE VALVE

Elesco Type "E" Superheater with tangential steam dryer and pyrometer, Model 496, must be applied. Header of cast steel must be American Throttle Co's multiple type suitable for 300 lbs. working pressure and must be secured to front tube sheet by ten 1-1/8" studs, with U.S.Form threads tapered 3/4" in 12" tapped through front tube sheet into dry pipe ring. Ends of header must be supported by two brackets, each secured to smokebox by six 1" straight turned bolts, double-nutted, as shown on drawing. Brackets must be correctly located after header has been placed in its proper position so that header bears squarely on supports without placing unnecessary strains on header. All as shown on drawing. Superheater units to be of seamless steel tubing 1-3/16" O.D. Header joints to be tightened after running test. Header must be tested under hydrostatic pressure of 375 lbs. per sq. in.

Header stuffing box to be made of cast steel, as shown on drawing, and welded to outside of smoke box. Stuffing box gland to be of cast iron as shown on drawing.

American Throttle Company's tangential steam dryer to be applied in steam dome of boiler as shown on drawings furnished.

Throttle to be of the American Throttle Co's front end multiple type with outboard bearing and in accordance with manufacturer's latest recommendations.

SYPHON VALVE

Syphon valve to be a 2" A.A.R. standard globe valve with extra strong wrought iron pipe nipple located as shown on boiler drawing.

TAPPED HOLES

All tapped holes in boiler, except where otherwise specified, must have 12" U.S.Form threads per inch.

TUBES AND FLUES

49 - 2-1/4" outside diam. tubes and 198 - 3-1/2" outside diam. flues 21' 6" long over tube sheets must be of open hearth seamless steel No.10 BWG thickness, and in accordance with A.A.R. specification M-108, latest revision. Alternate "ELECTRUNITE" electric resistance welded tubes meeting this same specification may be considered.

All 2-1/4" tubes must be beaded and set with copper ferrules on swedged ends in back tube sheet. In the front tube sheet, all of these tubes to be rolled and 20% to be beaded.

All 3-1/2" flues must be swedged to 3" diameter and set in back tube sheet by countersinking the hole, prossering and flaring the flues and then welding. In front tube sheet, all of these flues must be rolled and beaded.

The setting of all these tubes and flues must be

in accordance with drawing furnished.

TUBE SHEET LAYOUT

In back tube sheet, the minimum space between side of tube and inside of crown and side sheets must not be less than 2-1/2" and 1-1/2", respectively.

WAIST BEARER SHEETS

Waist bearer sheets to be used between all drivers and are to be made of 1/2" sheet steel as shown on drawings. Steel plates 7/8" thick must be welded to bearer sheets on the top edge and must fit snugly against boiler. Sheets must not be studded to boiler. Sharp edges to be removed from waist bearer sheets where shown on drawing.

WASHOUT PLUGS

Washout plugs must be of brass 2-1/16" in diameter 12-V threads per inch, tapered 1-1/4" in 12" applied in accordance with drawings furnished. Plugs must be applied so as not to extend more than 1/4" beyond inside surface of sheet, and must be accessible and not obstructed by piping. Long shank plugs, Style No. 2, to be used in washout holes in belly of boiler.

WELDED SEAMS

Inside corners of mud ring to have the sheets of firebox welded a distance from bottom of mud ring to a point midway between the first and second row of staybolts as shown on drawing. Inside and outside firebox sheets to be welded to mud ring 12" each way at four corners on caulking edge.

Inside throat sheet to be welded in complete, (except the bottom edge which is to be riveted to mud

ring), the welds to come between rows of staybolts all around, except at back mud ring corners as shown on drawing.

The longitudinal welded seams between the crown and side sheets of the firebox must be placed at least 15" below top of crown sheet. No welds to be permitted in crown sheet above this point.

Firebox door sheet to be butt-welded to side and crown sheets. Welded seam to be located between last two transverse rows of staybolts.

Builder must satisfy Railroad Company's inspectors that welders are qualified and satisfactory for the work required.

WELDING ON BOILER (GENERAL)

Fusion welding will not be permitted on staybolts, crownstays, braces or any part of the barrel or dome of the locomotive boiler where the strain to which the structure is subjected is not carried by other construction.

This will not prohibit welding at ends of butt straps to seal leakage, or prohibit the welding of staybolt sleeves to that portion of the barrel into which the combustion chamber extends.

The welding of studs, nipples and pipe connections to barrel of boiler, wrapper, or side sheets is prohibited. This shall not prohibit the welding of studs to sides and bottom of mud ring.

Use of acetylene torch is prohibited for cutting holes of any nature in boiler shells or liners. Removing broken studs from any part of the boiler by use of the acetylene torch is prohibited.

Any welding other than that indicated on drawings or shown in specification is not to be done without first being authorized by Railroad Company's inspectors.

ENGINE BED, ETC.

BED CASTINGS, ENGINE

Engine bed to be made of cast steel, and to be of design shown on drawing furnished, with main frames, back frame, deck plate, bumper, crossties, main cylinders, guide support, etc., cast integral. Special care must be used in foundry to insure sound castings free from porosity resulting from either gas or shrinkage strains.

Bed to be cast true and smooth and to be provided with necessary pads and renewable bushings where shown on drawing.

Bed to be machined and holes to be reamed in bed where indicated on drawings.

Frame clearance above all driving boxes to be 2-5/8". Sufficient vertical clearance must be provided in draw bar pocket in engine bed.

Pedestal caps as specified to be furnished with bed castings.

Bed castings are not to be painted by manufacturer.

DRAW BAR

Bushed unit draw and safety bars of double refined wrought iron, as shown on drawing, must be applied. Bars to be manufactured from hammered Laurel iron furnished by the Ewald Iron Company or from material of equal quality. Pin holes of draw bar must be provided with steel bushings not less than 5"

long. Pin hole in tender end of draw bar to be slotted. Surface of pin holes to be finished smooth and edges of holes to be trimmed off so that they will be smooth and free from burrs. Bushings to be applied in two-stage fit as shown on drawing. Bushings not to be welded.

DRAW BAR PIN

Draw bar pin, 6" diameter, to be made of double refined wrought iron in accordance with A.A.R. Specification M-307, latest revision, smooth forged as shown on drawing furnished. Pin to be lengthened to suit longer bushing.

DRAW CASTING, FRONT

Front draw casting to be of reinforced design as shown on drawing.

PEDESTALS, CAPS, SHOES AND WEDGES

Pedestals must be equipped with bronze shoes and wedges furnished by Magnus Company, unless otherwise specified. Shoes and wedges to have 1/4" radii in inside corners. Thickness of shoes must be 1" as shown on drawing. Each shoe and wedge must be clearly marked to show location on engine.

Shoe and wedge faces to be grooved as shown on drawing for oil lubrication and are to be supplied with oil from Nathan #3515 Four-Way oil distributors, one for each pair of driving boxes.

Pedestal toes to be 5" long, 7" wide, and depth as shown on drawing. Pedestal toe on inside face to be straight; outside face to be tapered 1" in 12".

Holes for pedestal cap studs, 1-1/2" diameter, to be taper tapped into bed by manufacturer for a distance of 1-5/8"; taper to be 3/4" in 12", U.S. Form threads. Pedestal cap studs and wedge bolts to be made of Mayari engine bolt steel or equivalent nickel steel, SAE-2115 and to be secured with Improved Hi-Power spring washer and one nut. Pedestal caps to be furnished with engine beds and must be forged steel, Class "A", in accordance with A.A.R. Specification M-104, latest revision. Pedestal cap draw to be not less than 1/8", nor more than 1/4". Contact surfaces between pedestal toes and caps must be accurately fitted to insure full metal to metal contact over the entire bearing surface.

[illegible] 1-1/2" [illegible], to

be transformed into bed by manufacturer for [illegible]

[illegible] 1-3/8"; [illegible] to be 3/4 in 12", [illegible]

[illegible]. [illegible] bolts [illegible]

[illegible] equal or equivalent metal

steel, [illegible]

[illegible], adjusted [illegible] to

be furnished [illegible] bolts and [illegible]

steel, [illegible], in accordance with [illegible] Specifi-

cation [illegible] Federal [illegible]

[illegible] 1/8", [illegible] 1/4". [illegible]

[illegible]

[illegible]

[illegible] the entire [illegible].

FIXTURES AND AUXILIARIES

AIR BRAKE EQUIPMENT

See "ACCESSORIES - AIR BRAKES" - .. Page 118

BELL

Bell, support, clapper, and attachments, must be of dimensions shown on drawings. Bell must be of bell metal in accordance with Material Specification CS-12-G, and must be supported by cast steel frame secured with tapered studs underneath the front end of smokebox as shown on drawing.

BELL RINGER

Transportation Devices Corporation quick acting bell ringer as shown on drawing must be applied.

BLOWER

Blower of 1" extra strong wrought iron pipe with A.A.R. 300-lb. fittings must be applied. Blower pipe line unions in smokebox must be forged steel 300# type WITHOUT BRASS INSERT IN JOINT. Blower must be operated with superheated steam. Manner of applying blower to be as shown on drawings.

Pipe connections for roundhouse steam line to be provided on left side of smokebox as shown on drawing.

Blower pipe from smokebox to boiler head must be located under lagging.

BLOW-OFF COCKS

One manually operated blow-off cock as shown on drawing to be applied to each side of firebox. Each cock must be substantially connected to boiler and provided with the necessary operating mechanism as illustrated on drawings.

Okadee centrifugal blow-off separator and discharge muffler, as shown on drawing, or alternate equivalent Wilson centrifugal blow-off muffler to be applied on top of boiler with vertical centerline of water drain pipe located 55" from center of engine so that discharge will be outside the end of the ties, but drain baffle must not project beyond 65-1/2" from the center of the engine, and must be located at a height within clearance limits furnished by the Railroad Company. Application to be similar to that shown on drawing entitled "APPLICATION OF WILSON BLOW-OFF MUFFLER."

If interconnected with discharge piping from Foam Meter muffler, piping from centrifugal blow-off muffler must be such that discharge will not back up into and overflow Foam Meter muffler when manual blow-off cocks are open.

BOOSTER ENGINE

See "TRUCK, TRAILING"....Page 112

BUMPER

Front bumper of cast steel to be integral with engine bed and must be in accordance with bed drawing. Clamps securing brake pipes to bumper must be applied as shown on drawing.

CAB

Cab must be of the enclosed type, of welded steel construction having roof lined with white wood of good quality and provided with window and door frames made of extruded aluminum and steel. Cab to be

similar to that shown on drawing furnished and must be designed to provide proper clearances on maximum curvature of 18°.

Access to cab to be provided by means of side ladders leading to swinging side doors made of steel having window section of extruded aluminum and steel. Provision must be made for passage from cab to tender by means of a ladder on the rear wall of the cab suitably designed with adequate handholds to allow passage through two-section swinging door located at top of rear wall of cab as shown on drawing. Passage through rear doors to be facilitated by designing rear roof ventilator so that it can be easily slid forward to allow additional space through which to pass. Rear edge of ventilator to fit down over rear doors in order to hold them in place when closed. Arrangement to be similar to that shown on drawing furnished. Rear door must be designed so that it can be securely clamped and will be free from noise due to vibration and rattling. Provision must be made so that rear door can be easily opened both from inside of cab and on gangway.

Partitions extending to cab roof, to be applied behind engineer's and fireman's seat boxes and are to serve as supports for seat back rests.

CAB APRON Hinged apron plate to be applied below rear doors

on engine and to extend to bracket on top of oil tank on tender as shown on drawing.

CAB ARM RESTS

Cab arm rests as shown on drawing must be applied to windows on each side of cab for enginemen, and equivalent arm rest must be applied on brakeman's drop seat.

CAB AWNINGS

Suitable cab awnings must be applied to side windows.

CAB BRACES

Cab must be substantially braced to boiler by means of two wrought iron braces, 1-1/8" diameter, applied between top of boiler head and rear wall of cab. Liners or filler blocks must be applied under foot of each brace; thimbles must not be used.

CAB BRACKETS

Cab to be supported from fixed brackets substantially secured to boiler and saddles on upper curved section of back head. Sliding cab supports, suitably clamped and provided with wear plates to be located underneath cab on each side. These sliding supports to be rigidly secured to engine bed casting. Means must be provided for lubricating the sliding surfaces on these supports.

CAB BULLETIN BOARD

Cab bulletin board in accordance with drawing must be applied.

CAB DRAINS

Suitable gutters and drain pipes to be applied to sides of cab. Deck drain to be provided in cab floor, consisting of a section of 5-3/8" O.D. boiler flue,

or equivalent, with hinged cover. Drain to be located on longitudinal centerline of cab floor about 20" from back head in accordance with drawing furnished.

CAB
FIXTURES

Cab fixtures to be located as shown on drawings furnished; special attention being given to locating all operating levers and valves in order that they shall be placed conveniently for enginemen. All lever handles and valve handles must clear nearest object by at least 2-1/4".

CAB
FLOOR

Steel flooring of cab must be of welded construction similar to that shown on drawing. Cab must be substantially riveted to floor with 5/8" rivets. Floor adjacent to boiler head must be removable and securely bolted in place. Plank flooring of ash must be applied on top of steel floor inside of cab.

CAB
HANDHOLDS

Cab handholds must be applied where indicated on drawings and wherever necessary for the safety and convenience of enginemen. All exposed handholds must be made of solid stainless steel rod 1" diameter. (Finish No.2)

CAB
HEATER

Cab heaters of sufficient size must be applied for engineer and fireman and additional heater of sufficient size must be provided at rear of cab to provide heat for brakeman. Separate controls must be furnished for engineer, fireman and brakeman. Cab heater pipes to be covered with wooden duck boards as shown on drawing.

CAB INSULATION

Cab must be arranged so as to be fully weatherproof. Entire cab, except roof, to be insulated with 2" thick flame-proof muslin covered fibre-glass, or equivalent Johns-Manville material. Insulation to be covered with 1/16" steel plate. Roof to be lined with white wood of good quality. Air space to be provided between roof sheet and wood lining in order to insure proper circulation of air and prevent condensation.

CAB LADDERS

Ladders of substantial construction must be applied on each side of engine, providing access to cab, and on rear wall of cab, providing access to rear cab doors.

CAB SANDBOX

Welded sandbox for sanding out boiler tubes and flues to be located under firedoor and securely fastened to cab floor with 3/4" bolts. Sandbox must have a capacity equivalent to box shown on drawing furnished.

CAB SEATS FOR ENGINEMEN AND BRAKEMAN

Three seats to be applied in cab in locations shown on drawing. One seat box to be provided on right side of cab for engineer and one on left side for fireman. Seats to be complete with backrests and are to be of design shown on drawing furnished. Backrests to be supported on partitions on each side of cab. Third cab seat of the drop type, complete with arm rest and back rest to be applied at rear wall of

cab on left side for use of head brakeman.

All seats and back rests to be of Dunlop Tire and Rubber Corporation's "DUNLOPILLO" sponge rubber construction, or equivalent material manufactured by U.S. Rubber Company or Firestone. All seats, back rests and arm rests to be covered with Zapon No.8077 HB Mustang or material equivalent in color and quality.

CAB STORM WINDOWS

Cab storm windows made of non-shatter glass .515" ±.025" thick, supported by metal frames as shown on drawing must be applied at front of engineer's and fireman's side windows. Glass to be held in place by Everseal strip .085" thick. Clearance of 1/16" must be provided between edge of glass and frame.

CAB VENTILATORS

Cab ventilators must be applied on roof of cab on top centerline of roof, one near front of cab and one near rear. Roof ventilators to be of the sliding type. Rear ventilator to run on rollers; front ventilator to be operated by rigging as shown on drawing. Rigging on front ventilator must be adjusted so that it can be operated easily by enginemen. Deflector to be applied on cab roof ahead of front ventilator as shown on drawing.

Swinging metal side ventilators, "PRIME" No.SC-950, must be provided on each side of cab near front, in location shown on drawing.

CAB WINDOWS, SIDE AND BACK

Cab side windows to be of the two section sliding type as shown on drawing. Small sliding windows to be located in rear wall of cab, one on each side in position shown on drawing. All sashes and frames must be of extruded aluminum and steel construction similar to design shown on drawing in order to support glass properly.

All cab windows to be made of Plexite (Plate and Sheet) non-shatter window glass; side and back windows to be .335" ± .025" thick, clear vision windows to be .515" ± .025" thick. Glass to be furnished and applied in accordance with manufacturer's recommendations. Clearance of 1/16" must be provided between edge of glass and frame for insertion of Everseal strip .085" thick.

CLASSIFICATION AND MARKER LAMPS

Classification and Marker Lamps must be equipped for electric light and located as shown on drawings. Classification lamp to be of the streamlined type as shown on drawing with switch on bottom of each lamp. Wiring and method of applying must also be as shown on drawings.

CLEAR VISION WINDOWS

Clear vision windows made of Plexite non-shatter glass .515" ± .025" thick, supported by metal frames as shown on drawing must be applied to windows on front wall of cab. Glass to be held in place by Everseal strip .085" thick. Clearance of 1/16" must

be provided between edge of glass and frame. Provision must be made for defrosting of clear vision windows by hot air jets.

CONDUITS, METAL

Franklin flexible metal sleeve joints, as shown on drawings, must be used on steam and oil connections between engine and tender as follows: 2-1/2" sleeve joint on steam heat line, 2" sleeve joint on oil feed line; 3/4" sleeve joint on steam line to heater in oil tank.

COPPER TUBING

Seamless copper tubing, in accordance with Material Specification C.S. 16-A, must be used for the following purposes and have the dimensions as shown:

Air Compressor governor control pipes 3/8" O.D. No. 16 BWG.

Air pipe for preliminary throttle valve for booster 1/2" O.D. No. 14 BWG.

Air piping for sander 3/8" O.D. No. 16 BWG, 1/2" O.D. No. 14 BWG.

Air piping for tank level indicator 3/8" O.D. No. 16 BWG.

Air and steam piping to power reverse gear 3/4" O.D. No. 13 BWG.

Application pipe to distributing valve 1/2" O.D. No. 14 BWG.

Bell Ringer Pipes 1/2" O.D. No.14 BWG and 5/16" O.D. No. 16 BWG.

Controlled emergency pipe to distributing valve 1/2" O.D. No. 14 BWG.

Gage Cock drip funnel drain pipe 1" O.D. No.12 BWG. Cylinder cock pipes 1/2" O.D. No.14 BWG and 3/8" O.D. No. 16 BWG.

Guide Oiler pipes 3/8" O.D. #16 BWG.

Independent release pipe to distributing valve, 1/2" O.D. No. 11 BWG.

Lubricator pipes - Hydrostatic, 5/8" O.D. No. 14 BWG.

Lubricator pipes - Mechanical, 1/2" O.D. No. 14 BWG; 3/8" O.D. No. 16 BWG.

Pipe from boiler to water column 1-1/2" O.D. No. 11 BWG.

Pipe from boiler to water glass 5/8" O.D. No. 14 BWG.

Pipes to dome pilot valve for booster 1/2" O.D. No. 14 BWG.

Pipe from dome pilot valve to booster throttle operating cylinder 1/2" O.D. No. 14 BWG.

Pipe from signal valve to whistle 3/8" O.D. No. 16 BWG.

Piping to all gages except to steam chest pressure 3/8" O.D. No. 16 BWG.

Pipes to steam chest and back pressure gages 3/8" O.D. 16 BWG & 1/2" O.D. No. 14 BWG.

Pipe to equalizing reservoir 5/8" O.D. No. 14 BWG.

Pipes to air operated cylinder cocks 1/2" O.D.No. 14 BWG 3/8" O.D. No. 16 BWG.

Pipe from booster reverse lever pilot valve to manifold 1/2" O.D. No. 14 BWG.

Pipe from booster reverse lever pilot valve to main air reservoir 3/4" O.D. No. 13 BWG.

Pipes to timing reservoir for booster 1/2" O.D. No. 14 BWG.

Reducing valve pipe to signal line 5/8" O.D. No. 13 BWG.

Steam heat pipe from turret to reducing valve 2-3/4" O.D. No. 10 BWG.

Steam pipe to lubricator 1" O.D. No. 12 BWG.

Steam pipes between injector steam valve and injector, 2-3/4" O.D. No. 10 BWG.

Water column drain pipe 1" O.D. No. 12 BWG.

Water glass drain pipe 5/8" O.D. No. 14 BWG.

Water cooler air control piping 1/2" O.D. No.14 BWG, 3/8" O.D. 16 BWG.

All copper tubing for air attached to boiler must be located under jacket, i.e., between jacket and lagging. Couplings must be located outside jacket in an accessible location. This includes all copper tubing in cab.

Copper tubes passing through wall and floor of cab must be protected with double pipe protection collars and flanges. This includes all steam pipes, water column, water gages, injector and steam heat line. All as shown on drawings.

All copper tubes passing through jacketing must be protected by single pipe protection collars and flanges as shown on drawing.

Under no circumstances will builder be permitted to use copper tubes threaded for standard pipe fittings.

All copper tube fittings to be in accordance with drawings furnished.

COUPLER

Coupler must be in accordance with drawing and horizontal centerline of same must be located 33-1/2" above rail, locomotive ready for service.

DRAFT GEAR, RADIAL

Franklin Railway Supply Company's spring Type E-2 radial buffer as shown in their Bulletin No.328-B must be applied between engine and tender and must be equipped for oil lubrication as shown on drawing. Parts of radial buffer must be accurately aligned and all wearing surfaces must be free from foreign matter and properly lubricated before leaving Builder's works.

Wearing faces on stationary and adjustable buffers to be hardened. Floating chafing block not to be hardened.

ENGINE NUMBER INDICATORS.

See "TRAIN AND ENGINE NUMBER INDICATORS."

FEEDWATER HEATER

See "WATER SUPPLY, FEEDWATER HEATER."

GAGE COCKS AND WATER GLASSES

Brass water column and fittings of design shown on drawings furnished are to be applied on right hand side of back head of boiler. Lower connection of water column must be forged steel as shown on drawings and must be located approximately 4" from back head with connection direct to boiler; column to have necessary connections for water glass and gage cocks. Top connections for water column to be connected to steam space of boiler by 1-1/2" O.D. copper pipe in accordance with drawing furnished.

Each column must be given a hydrostatic test of 550-lbs. per square inch and be free from leaks. Water column drain valve to be 3/4" A.A.R. standard angle valve.

Two water glasses must be applied, one located on the water column and one on left hand side of boiler head. This latter glass to have lower connection made direct to boiler and the top connection to steam space of boiler by 5/8" O.D. copper pipe.

Special care must be taken to see that steam connections to water column and water glass are applied without any sags, traps or pockets being formed.

Three gage cocks, located on water column to be applied as shown on drawing. Bottom gage cock and lowest reading of water glasses must be located at a height of 3-1/2" above the highest point of the crown

sheet, engine level.

Water column and water glass drains at cab floor must be accurately aligned with drain pipes to prevent splashing of water over cab floor.

HANDRAILS AND HANDHOLDS

Handrail arrangement to be as shown on drawings entitled "ERECTING DIAGRAM" modified to suit enclosed cab design. All exposed handrails and handholds must be made of stainless steel rod, 1" diameter, except left handrail which must be stainless steel pipe 1" O.D. to serve as conduit for electric wiring. Finish on stainless steel to be No. 2. Handrails to be supported by clamp type cast steel columns as shown on drawing. Additional handholds must be applied to locomotive wherever required for safety and convenience of enginemen.

HEADLIGHT, FITTINGS, ETC.

Headlight must be Pyle-National cast aluminum round case type 14601-CE, equipped with 14" non-glare glass reflector and focusing device secured to reflector shield; all as shown on drawing. Case to have clear front door heat resisting convex glass.

Headlight to be installed at center of smokebox front door on locomotive as shown on drawing. Doors and holders for engine number indicators must be provided on each side of headlight case. Suitable means must be provided to enable men to work on headlight conveniently.

Mars Signal Light to be applied on smokebox front above headlight in accordance with manufacturers' recommendations. Light to be furnished by Loco.Builder and to be fitted into contour of front end design.

Storage case for spare headlight globe as shown on drawing to be provided in cab.

Pilot beam and rear of tender tank must be equipped with receptacles P.N. No. HRA-12 placed facing out, for marker lamps.

Headlight wiring to be in accordance with draw-

In order to prevent ball bearing failures, wear on main shafts, noisy operation and improper voltage regulation caused by distortion of turbo-generator frames, turbines must not be bolted down on platforms until feelers 1/32" in thickness are used under feet of turbine to determine whether or not shims are necessary. If a space of 1/32" or more exists under feet, a metal shim of proper thickness must be applied.

HORN, AIR

Tyfon Air Horn, size A-200-L, manufactured by Leslie Company of Lyndhurst, N.J., as shown on drawing furnished, must be applied at front of smokebox under skyline casing on left side. Horn to be complete with Viloco operating valve, relay valve and self-cleaning strainer. Piping to horn must be extra strong and substantially braced. Air horn to be operated by Viloco pneumatic whistle operator located conveniently on engineer's side of cab.

INJECTOR

See "WATER SUPPLY, INJECTOR & FEEDWATER EQUIPMENT".

MANIFOLD FOR OIL BURNER PIPING

Two-section cast steel manifold to be applied in cab on fireman's side of backhead as shown on drawing. Design of manifold to be similar to that shown on drawing except that two-sections are to be provided; one for supplying superheated steam to atomizer, blower, FWH heater, and booster heater; the other section for supplying saturated steam to oil heater, oil

tank heater, blowback, and cab heaters. Manifold, oil piping and steam piping must be insulated as shown on drawings. Hydrostatic test of 550 lbs. per sq. in. must be applied to each manifold and manifold must be free from leaks under this pressure.

NUMBER PLATE

Cast iron number plate, as shown on drawing, must be centrally located and bolted to underside of transverse deck plate at front of locomotive as shown on drawing. Number plate to be provided with 4" polished aluminum figures as shown on drawing.

OIL AND DAMPER REGULATORS AND RIGGING

Oil regulator shaft must be located at fireman's side of cab as shown on drawing with all operating parts properly aligned and rods given proper lead so that regulator can be operated by fireman easily with one hand.

Oil damper regulator to be of chain type and located on fireman's side of cab. Design to be similar to that shown on drawing and must provide for easy operation of oil damper.

OIL BURNER

A 3-1/2" Von Boden-Ingles brass oil burner, in accordance with drawing must be applied. Care must be taken to see that burner is in proper alignment both horizontally and vertically. Superheated steam must be used for atomization of oil in burner.

OIL FEED PIPE LINE - DIAL THERMOMETER

Ashcroft American 4-1/2" dial thermometer, type 603-RB, as shown in Bulletin 177 of Locomotive Equipment Division of Manning, Maxwell & Moore, Inc., must be applied with bulb connected to tee fitting in oil feed pipe line between heater and oil burner. Dial thermometer must have graduations from 0° to 300° Fahr. (black dial, white figures) and be fitted with bronze armored connecting tubing with union connection bronze bulb. The dial thermometer must be placed on Fireman's side of cab in a convenient location where he will have an unobstructed view of same. All as shown on drawings.

OIL HEATER

Oil heater must be applied on the oil feed pipe line of engine, as shown on drawings. Oil heater to be supplied with saturated steam.

PILOT

Pilot to be made of structural steel as shown on drawing furnished.

RUNNING BOARDS

Running boards must be Ryerson's "Four-way" steel plate 3/16" thick, or alternate Central Iron & Steel Company's "All-Way Grip" plate, bound with 2" x 2" angle irons riveted to under side of plate around outer edge. Running board must extend 5" beyond outside of cab to provide footing for enginemen to pass to front of locomotive. Brackets must be lined up to have running boards straight. Running boards not to be pulled out of line to suit brackets.

SAFETY VALVES

Two 3-1/2" locomotive pop safety valves, as specified, must be applied, one valve with muffler set at 280 lbs.; and one valve without muffler set at 282 lbs. pressure. Space to be provided for application of third safety valve, but boiler not to be tapped for same. Fittings for attaching safety valves to boiler to be furnished by locomotive builder in accordance with drawing.

SAND BOXES

Sand box and cover of size and design shown on drawing must be applied on top of boiler for sanding track. Capacity of box to be about 2500 lbs. of sand. Sand box must be located and designed to conform with contour of skyline casing and form a part thereof.

SANDER

Viloco outside locomotive air sanders type FLA-317 and duplex engineer's valve No.255 for operating same as specified, must be applied. All air piping to sander and engineer's valve must be copper tubing.

Air piping from engineer's valve to sander must be applied under skyline casing and secured where shown on drawing. The four sand pipes on each side of locomotive leading from sander to rail must be 1-1/4" iron pipe applied under boiler jacket and secured to frame in manner shown on drawing. Care must be taken to eliminate sharp bends in sander pipes.

Sand is to be delivered to the front of second (main) and third pairs of drivers; to rear of third pair of drivers; and to front of rear pair of trailing wheels for booster engine.

Sand box on top of boiler to be equipped with a sand agitator. Agitator operating valve to have warning port so engineer will know when valve is open. Valve to be located so warning port will not be directly opposite pipes or other objects in cab.

Sander operating valves to be located so warning ports will not be directly opposite pipes or other objects in cab.

Sander piping to be arranged as shown on drawing for automatic sanding when emergency brake application is made. For list of parts furnished by Railroad Company, see Specialty Spec. L-191; all other necessary parts to be furnished by Builder. 5-D vent valve to be located not over 10 ft. from sanding reservoir so there will be not over 25 ft. of sander pipe. 3/8" check valve to be located in line close to where it connects into air line from cab sander valve to front sand trap.

SIGNAL BRACKETS

Signal brackets as shown on drawings must be located in accordance with drawing.

SIGNAL FOAM METER AND ELECTRO-MAGNETIC BLOW-OFF COCK

Electro-Chemical Engineering Corporation's Signal Foam Meter, Model "GES" and Electro-Magnetic Blow-Off Equipment must be applied in manner shown on drawings. Length of long and short electrodes to be 6" and 2-1/2", respectively. Eyelets to be attached to ends of all wires connected to terminal posts to insure good connections.

Foam Meter Indicator must be located on engineer's side of cab in convenient location where he will have unobstructed view of same. Foam Meter muffler to be applied on top of boiler with vertical centerline of water drain pipe located 55" from center of engine so that it will discharge beyond the end of ties of track, but drain baffle must not project beyond 65-1/2" from center of engine, and must be located at a height within clearance limits furnished by the Railroad Company. If discharge piping from Foam Meter muffler is interconnected with that from the centrifugal muffler in the manual blow-off system, provision must be made so that discharge from manual system will not back up into and overflow the Foam Meter muffler when manual blow-off cocks are open.

SKYLINE CASING

Skyline casing to be applied to top of boiler as shown on drawing. Casing must be provided with all necessary doors and panels to facilitate inspection of staybolts, domes, etc.

SMOKE LIFTER

Smoke lifter of design shown on drawing entitled "SKYLINE CASING" to be applied around stack on top of smokebox of boiler.

SPEED AND CUT-OFF INDICATOR

Speed and cut-off indicator, Locomotive Valve Pilot Model VP-120, must be applied as shown on drawings, and in accordance with manufacturer's recommendations.

Indicator must be located on engineer's side of cab in a position shown on drawing where it is readily accessible and can be easily seen by engineer.

STEAM CHEST AND BACK-PRESSURE GAUGE

One 6-3/4" dial steam chest and back-pressure gauge, as specified by the Railroad Company, to be applied on engineer's side of cab in a position so that engineer has an unobstructed view of it from his seat box. Method of piping to be similar to that shown on drawing.

STEAM GAUGES

Two 6-3/4" dial locomotive steam gauges, as specified by the Railroad Company, must be applied, one on each side of the back head of the boiler, similar to drawing furnished. Gauges to be graduated from 0-500 lbs. Hard rubber cushion to be applied behind steam and air gauges.

STEAM HEAT EQUIPMENT

See "ACCESSORIES - STEAM HEAT," Page 123

STEAM PIPE INSULATION

Steam piping in cab and steam pipes leading from steam turret to air compressors, feedwater heater and headlight turbo-generators must be insulated with Unarco "Insutape" material, waterproofed on one side, 2-3/8" wide, and not less than 3/8" thick, wrapped on pipe spirally with edges butting and securely wired on. Superheated steam pipe line from superheated header to turret outside of boiler and steam heat line to be insulated with Unarco "Wovenstone" material 1" thick.

All other steam pipes, unless otherwise specified, must be covered with Unarco "Insutape" insulation in accordance with manufacturer's recommendations.

STEPS

Steps must be applied where shown on drawings furnished and wherever necessary to provide for the safety and convenience of enginemen. Cast iron steps for sand box and turbo-generators must be applied to right and left sides of boiler as shown on drawings.

A transverse step of steel plate and angles extending across the locomotive at front end must be applied as shown on drawing.

STRAINERS

A Keckley self-cleaning strainer to be applied in the booster air line in position where it is accessible for cleaning.

STREAMLINING

Engine and tender to be streamlined as shown on drawings. Skyline casing extending from front of engine and terminating at cab to be applied on top of boiler.

Removable panels fastened with machine screws to be provided over stayed portion of firebox to facilitate inspection and repair work.

Running board skirting to extend from pilot to cab as shown on drawing.

Inspection doors must be provided in skyline casing and running board skirting at all points shown on drawing.

SUPERHEATED STEAM PIPE LINE FOR AUXILIARIES

For supplying superheated steam for auxiliaries, a 2-1/2" extra strong wrought iron pipe with A.A.R. standard 300-lb. pressure fittings must be applied outside the boiler on left side connecting superheated turret with superheater header. Pipe line to pass under skyline casing.

A 3" Merco-Nordstrom valve must be located in the superheated steam line, as shown on drawing.

A 2" Consolidated Form "DX" safety valve or equivalent Ashton safety valve, as shown on drawings, set at 310-lbs. pressure, must be placed between the Merco-Nordstrom valve and the throttle header.

SUPERHEATED STEAM PYROMETER

Elesco superheated steam pyrometer, Model 496, to be located on engineer's side of cab in plain view from seat box and to be applied in accordance with manufacturer's recommendations.

TEST PLATE, BOILER

Test plate, as shown on drawing, must be located on centerline of back head of boiler above fire door, and provided with casing as shown on drawing.

TORPEDO, FLAG AND FUSEE BOX

Box for torpedoes, fusees and flags, as shown on drawing, must be applied in cab.

TRAIN AND ENGINE NUMBER INDICATORS

Train number and engine number indicators must be equipped for electric light and located as shown on drawings. Train number indicator to be applied on each side of streamlined skyline casing in front of centerline of smokestack; engine number indicator

to be applied on each side of headlight on smokebox front. Wiring and method of applying must be as shown on drawings.

TURRETS, STEAM

Two cast steel turrets, as shown on drawing, must be applied to locomotive for supplying steam. One turret, located on top of left side of boiler near cab end, to supply superheated steam to feedwater heater, air compressors, booster and to superheated section of manifold for atomizer, blower, FWH heater and booster heater.

The other turret, located on top of right side of boiler near cab end, to supply saturated steam to injector, hydrostatic lubricator, turbo-generators, steam heat, mechanical lubricator heater, emergency connection to power reverse gear, and to saturated section of manifold for oil heater, oil tank heater, blowback and cab heaters.

Each turret must be given hydrostatic test of 550-lbs. per sq. in., and be free from leaks under this pressure.

Shut-off valve handle for saturated steam turret to project about 2-1/2" through top of skyline casing with valve closed.

VALVE EXTENSION HANDLES

Valve extension handles located as shown on drawing entitled "Extension Handle Support", must be provided for feedwater heater, saturated section of to be applied on each side of headlight on smokebox front. Width and method of applying must be shown on drawings.

TURRETS, STEAM. Two cast steel turrets, as shown on drawing, must be applied to locomotive for supplying steam. One turret, located on top of left side of boiler near cab end, to supply superheated steam to feedwater heater, air compressors, booster and to superheated section of manifold for stoker, blower, FWH heater and booster heater.

The other turret, located on top of right side of boiler near cab end, to supply saturated steam to injector, hydrostatic lubricator, turbo-generator, steam heat, mechanical lubricator heater, emergency connection to power reverse gear, and to saturated section of manifold for oil heater, oil tank heater, blowback and cab heaters.

Each turret must be given hydrostatic test of 500-lbs. per sq. in., and be free from leaks under this pressure.

Shut-off valve handle to each turret steam port to project about 2-1/2" through top of skyline casing at valve wheels.

VALVE EXTENSION HANDLE. Valve extension handle located as shown on drawing entitled "Extension Handle Support", must be provided for feedwater heater, auxiliary section of manifold, superheated section of manifold, air compressors, water gauge, injector steam, turbo-generators, lubricator, steam heat, and power reverse steam valves in turret. Universal joints used with extension handles must be A.A;R. standard, and nuts securing extension rod to joint must be provided with Hi-power Spring Washers.

VALVE HANDLES

All globe and angle valves furnished by the Locomotive Builder must be equipped with A.A.R. standard handles. All valves must be suitably tagged for identification purposes.

VALVES, SATURATED STEAM

All valves used on saturated steam pipe lines, except where otherwise specified, must be A.A.R. standard 300-pound working steam pressure valves.

VALVES, SUPERHEATED STEAM

All valves used on superheated steam lines must by A.A.R. standard type valves made of Monel metal, and suitable for 400-pounds working steam pressure and 750° F. superheated steam temperature. Valves to have outside bonnet and union nut.

WATER COOLER FOR DRINKING WATER

Water cooler for drinking water of design shown on drawing must be located in cab in position shown on drawing so that it can be conveniently reached by enginemen.

WATER COOLER PIPING, DRIVING AND TRAILING TIRES

All driving tires and rear trailing wheel tires, as well as all tender wheels, to be cooled by water taken from the tender tank through an air-controlled

water cooling system which operates automatically whenever brakes are applied. System to consist of an outlet from the water tank operated by an air-controlled valve and a longitudinal pipe with lateral branches to the tires, each branch terminating in a spraying nozzle.ø All pipes and pipe nipples to be extra strong with A.A.R. 300 lb. fittings and must be substantially clamped. Piping to be arranged to clear spring rigging and wheels in high position. Arrangement to be similar to that shown on drawing furnished.

WATER COOLER PIPING, TRUCK JOURNALS

Provision must be made for cooling truck journal boxes with water piped directly from tender tank through an independent longitudinal pipe line. Globe shut-off valve to be applied at end of each lateral branch of pipe line at journal box connection.

Holders for carrying water hoses when not in use must be applied as shown on drawing entitled "METHOD OF SECURING WATER HOSE TO TRUCK FRAME". All pipes and pipe nipples to be extra strong with A.A.R. 300 lb. fittings and must be substantially clamped. Piping to be arranged to clear spring rigging and wheels in high position. Arrangement to be similar to that shown on drawing furnished.

ø - Cutout cock to be located in convenient position on engineer's side of cab to render cooling system inoperative when desired.

WATER SUPPLY:
FEEDWATER
HEATER
EQUIPMENT

Worthington Type 5-1/2 - SA Feedwater Heater must be applied in accordance with manufacturer's latest practice and recommendations.

WORTHINGTON FEEDWATER HEATER EQUIPMENT (Type 5½-SA) (capacity 10,200 gallons of water per hour to boiler)

Worthington equipment furnished by the Railroad Company to consist of the following: One feedwater heater; one steam turbine driven centrifugal cold water pump; one steam driven direct acting hot water pump; and such other parts as are regularly furnished by the manufacturer for this equipment, including standard "SA" type gauge. All other parts, including throttle valve, steam turret valve with outside screw bonnet and union ring, piping, and fittings must be furnished by the Locomotive Builder.

Feedwater heater, hot water pump, cold water pump, and other feedwater heater parts to be located on locomotive in positions recommended by the manufacturer and as shown on drawings.

Throttle valve for feedwater heater, furnished by locomotive builder, to be of the A.A.R. cone type of Monel metal suitable for superheated steam, and must be applied so that operating handles will be in location within convenient reach of fireman from his seat box.

All feedwater heater piping must be extra strong wrought iron pipe with A.A.R. 300 lb. fittings. Cold pump exhaust to be piped into smokebox as shown on drawing. All joints must be perfectly tight and all flanged pipe connections must be of steel equipped with ground ball joints.

Special care must be taken in assembling the discharge piping from the cold water pump to insure that pipe is properly sloped upward toward the smokebox end in order to prevent air traps or pockets from forming in line.

Fire inspirator must be applied on feedwater heater hot water pump discharge pipe line to boiler check; all as shown on drawings.

An air vent drain outlet must be located outside of rails, about 15" above rail where it can be readily seen by engine inspectors. Hot water pump stuffing box drain, also steam turbine exhaust drain and stuffing box drain, must all have outlets located about 12" above rail and about 3" in from inside of rail, in a position where they can be seen from outside of locomotive. Drain not to discharge on rail. All drain pipes must be securely braced.

Tank hose and clamps, furnished by the Railroad Company, to be 4-1/2" inside diameter as shown on drawing and of suitable length for use on feedwater heater suction line between engine and tender.

For feedwater heater boiler check, see "FEEDWATER AND INJECTOR EQUIPMENT".

WATER SUPPLY: FEEDWATER & INJECTOR EQUIPMENT

See drawing entitled "FEEDWATER EQUIPMENT". The following Nathan injector equipment will be furnished by the Railroad Company: One #17 Simplex Type "HW" Non-Lifting Injector, suitable for 300 lbs. pressure and capable of supplying 10,000 gallons of water per hour to boiler; one cab stand for injector operating rods; one 3" Type FWR reversible boiler check with stop valve (less spring) for injector; one 2-1/2" steam turret valve with outside screw bonnet and union ring; one 2-1/2" balanced lever starting valve; and one feedwater strainer, complete for 4" suction pipe with 3" bushing to be used on injector suction line. All other parts including piping required for the application of injector equipment must be furnished by the Locomotive Builder.

Injector to be located underneath cab on left side of locomotive, with operating handles extending

through floor up into cab providing for convenient operation by fireman. Balanced lever starting valve to be located on top of injector below cab. Starting lever to be located on fireman's side of cab in front of seat box in position from which it can be conveniently reached by fireman. Injector steam valve to be located on saturated steam turret and connected to injector by 2-3/4" O.D. copper tubing in manner shown on drawing.

All wrought iron injector piping to be extra strong with A.A.R. 300 lb. fittings. Injector suction and delivery lines to be 3" wrought iron pipes. Pipe lines must be free from leaks and properly secured by brackets to eliminate vibration. 3" injector boiler check must be located on left side of boiler and delivery line to check must be fitted into position without being sprung into place. All pipe joints must be tight.

Injector overflow spreader to be applied at bottom of overflow pipe as shown on drawing, approximately 10" above rail. Spreader to be located so that overflow will not discharge on rail.

Tank hose and clamps, furnished by the Railroad Company, to be 4-1/2" inside diameter as shown on drawing and of suitable length for use on injector suction line between engine and tender.

In addition to the injector equipment listed above, the Railroad Company will furnish the following Nathan material to be used in connection with the feedwater heater system: One 3" FWR reversible cushion type boiler check with stop valve.

Feedwater heater boiler check to be located on right side of boiler. 3" delivery line to boiler check must be fitted into position without being sprung into place.

WATER TANK
LEVEL
INDICATOR

Ashcroft-American Locomotive Tank Level Indicator, Type 1189-T, or equivalent indicator manufactured by Ashton, must be applied on fireman's side of cab to indicate water level in tender tank. Gage must be placed in a convenient location where fireman will have an unobstructed view of same.

Ashcroft equipment furnished by the Railroad Company to consist of indicator, type 1189-T, per bulletin 175 B, complete with air pressure reducing and relief valve (Type 2695), and air strainer (Type 2298). All other parts, including valves and piping required for proper installation of this device are to be furnished by the Locomotive Builder.

Indicator to have black dial with etched white figures and graduations. Strainer to be applied in air supply line ahead of indicator connection, with strainer cap pointing down.

Special attention must be given to making all joints on the lines air tight to insure against small air leaks. Air lines including all joints must be tested under air pressure with all joints covered with soap suds. All joints, connections, etc., must be free from leaks under working pressure.

WHISTLE, STEAM

Hancock long-bell chime whistle with nickel alloy steel bowl and valve and bronze bell, as shown on drawing must be applied. Whistle to be controlled from engineer's side of cab by Viloco pneumatic whistle operator conveniently located. Whistle to be located on steam pipe line leading from superheater header to superheated steam turret on left side of boiler. Whistle location to be back of steam dome on third course.

Blower and mechanism to be so constructed to operate whistle properly with superheated steam at 300 lbs. boiler pressure and at various air pressures encountered in locomotive operation.

MACHINERY

GENERAL

Machinery to be designed for 106 miles per hour.

ALEMITE AND PRESSURE GREASE LUBRICATION

Alemite lubrication must be applied to power reverse gear, crosshead pins, knuckle pins of side rods, engine truck center pin, steam chest valve rod crosshead pins, steam chest valve rod crosshead guides, link blocks, valve motion rods, etc., all as shown on drawings. All Alemite fittings must be #1396 with 3/8" thread.

Pressure grease lubrication must be applied to crosshead pin, all crank pins, eccentric crank pins, etc., all as shown on drawings. All pressure grease fittings must be in accordance with and applied as shown on drawings.

AXLES, DRIVING

Driving axle material must be in accordance with Material Specification C.S. 2-C. Design of axles to be as shown on drawing. Driving axles will be furnished to builder rough-turned only and with hollow bores rebored after heat treatment. Nominal size of main journals must be 13" diameter, 14" long; all others 12" diameter and 14" long. Lengths of journal surfaces must be finished to 17" except lateral motion (#1) driving axle journals, which must be finished to 18" length; all as shown on drawing. All journals must be rolled. Driving axles to be given a smooth ground finish between journals by the locomotive builder to the satisfaction of Railroad Company's

inspectors.

Axle manufacturer to rough bore hollow bores in driving axles 1/8" undersize, heat treat axles, and then rebore them to size shown on drawing.

Wheel center fits on axles to be turned taper with larger end of taper at inner end of wheel fit. Taper to be such that inner end of wheel fit will be .003" larger in diameter than outer end; tolerance on taper to be - .001", + .000". Last 1-1/2" from larger end of taper fit to be ground off on taper established by finished cut, making a continuous tapered surface from tooled portion to ground portion.

Allowance for fit to be measured at outer end of wheel fit and must be such as to obtain a mounting pressure of not less than 10 nor more than 15 tons per inch diameter of wheel fit.

BEARINGS,
DRIVING BOX

Driving box bearings manufactured by the Magnus Company to be furnished by the Railroad Company and finished all over to dimensions shown on drawing by the Locomotive Builder. Oil groove and holes to be located as shown on drawing. Serrations must be accurately machined into crown and front face of bearing in manner shown on drawing for holding lining metal in place. Lining metal to consist of 85% tin, 10% antimony, and 5% copper and is to be applied to bearing before pressing into box. Bearings to be

pressed in from side of box when box and bearing are cold and at a minimum pressure of 1-1/2 tons and a maximum pressure of 2 tons per inch length of journal. Jaws at bottom of driving boxes must not spread more than 1/32" under any circumstances after bearings are pressed in.

Bearings must be spotted when applying to journals so that an even contact will be made to insure proper lubrication.

BOXES, DRIVING

Driving boxes to be cast steel of design shown on drawing, modified to suit drawing entitled "CHANGES IN DRIVING BOXES FOR OIL LUBRICATION" and made to fit standard gages. Driving boxes to be finished where indicated on drawing, including spring saddle seat on top of box. Stop lugs for spring saddles to be welded on after top surface has been finished. Oil holes leading to bearing and pockets for lubricating shoe and wedge faces are to be accurately located in box and drilled as shown on drawing. Pockets on top of box to be filled with wool waste and 1/8" steel cover plate to be welded over pockets to prevent dirt and foreign matter from entering pockets. Top dust guard retainer to be secured to box by four 1/2" studs tapped into box as shown on drawing. Retainer and serrated dust guard to be made of brass and secured together as shown on drawings. One ply "Velumoid"

gasket about 1/64" thick to be applied between retainer and driving box.

Face of driving box next to wheel hub must be lined with Satco metal having brass inserts as shown on drawing. Spacer bolts to be Mayari engine bolt steel or equivalent nickel steel, SAE 2115.

Driving box spacers to be made of cast steel of design shown on drawing.

"Alco" lateral driving box cushioning device, as shown on drawing, allowing 3/4" lateral on each side, must be applied to driving boxes on first pair of driving wheels. Pads to be applied to driving boxes to take the wear of cushioning device. Lateral motion boxes must be adjusted so as to produce minimum wear on tires.

CELLARS, DRIVING BOX

Driving box cellars must be made of cast aluminum alloy of composition and to dimensions shown on drawing with cast brass dust guard having 1/4" thick "Corprene" insert applied to inner or hub wall of cellar. Dust guard to be held in place by tempered flat steel spring. Hard felt pads to project through bottom portion of hub face of cellar and to extend 1/8" beyond Satco lining on box for the purpose of lubricating hub face of wheel. Felt pads to be saturated in oil for twelve hours before applying cellars to boxes. Oil sight gauge made of brass to be applied to inner face of cellar in location shown on drawing. Sight gauge to be secured to cellar by five No. 8 brass machine screws. 1/16"

cork gasket to be provided with sight gauge. Wearing plate made of #14 gauge sheet steel to be applied on bottom of cellar. Cellars to be held in place by two spring loaded locking levers pivoted on journal box. Locking lugs on cellars to be provided with spring steel wearing plates cast into cellar. All as shown on drawings. Clearance between radius on cellar and journal must be not less than 1/16" nor more than 1/8". Locking lever studs to be made of Mayari engine bolt steel or equivalent nickel steel, SAE 2115.

CONNECTING RODS

Connecting rods must be of carbon steel, normalized and drawn, in accordance with Specification C.S.2-C and of design shown on drawing. Rods to be forged without grease cavities or lugs for same as bearings to be lubricated internally through crank pins. The area of the cross section of the ingot shall be at least four times that of the finished forging.

Rods to be finished smooth and polished with corners ground or draw filed to 3/16" radius. Hunt-Spiller gun-iron fixed bushings to be applied in intermediate side rods at main and intermediate crank pins, and outer fixed bushing in main rod at main pin. Floating bushings to be slightly countersunk on inside to remove burrs. Fixed brasses and bushings are to be secured by press fit only, without the use of keys or keeper bolts, and are to be pressed into rods at a

pressure of not less than 2-1/2 tons nor more than 3-1/2 tons per inch outside diameter of bushing. Rod brasses at fourth drivers to have 1/16" lateral play and 1/8" at first drivers.

Rods must be free from nicks and burrs, and must be suitably crated so as to protect them from being nicked during shipment.

CRANK PINS

Crank pin and crank pin collar material must be in accordance with Specification C.S. 2-C, and must be of design as shown on drawings modified to provide internal lubrication on front and back crank pins. Main pin must be enlarged so that stress as figured by A.A.R. method does not exceed 15,000 lbs. per sq. in. Nuts located on outside end of crank pins to be of special design providing for double cotter of 1/4" soft iron wire with ends riveted over nut as shown on drawing. All pins must have hollow bore to serve as grease container for purpose of automatically lubricating bearings. Grease holes in pins to be located on side of pin opposite center of driving axle as shown on drawing. **Hollow bores in crank pins to be rebored smooth after heat treatment; main crank pins by manufacturer and other pins by locomotive builder.**

Wheel centers, after being mounted, but before tires are applied, must be placed in quartering machine and the holes for crank pins bored out, correct

both as to stroke and quarter, and pins applied.

Method of finishing crank pins to be as follows:

Fits on crank pins to be turned taper with larger end of taper at outer end of wheel center fit. Taper to be such that outer end of wheel center fit on crank pin will be .003" larger in diameter than inner end; tolerance on taper to be - .001", + .000". Last 1-1/2" from larger end of taper fit to be ground off on taper established by finished cut, making a continuous tapered surface from tooled portion to ground portion.

Allowance for fit to be such as to obtain a mounting pressure of not less than 10 nor more than 15 tons per inch diameter of wheel fit.

After crank pins have been pressed in, they must be trued up in quartering machine to insure their being correct both as to stroke and quarter and then riveted over at back as shown on drawing. Hydraulic presses for mounting crank pins must be equipped with a recording device so that pressure can be read for the entire length of crank pin fit.

CROSSHEADS

Multiple bearing type crossheads made of cast nickel manganese steel of 60,000 p.s.i. yield point 22% elongation, or equivalent as shown on marked print of/ drawing must be applied with wearing surfaces tinned and lined with Grade 1 ingot tin in accordance with Material Specification C.S. 35.

Crosshead pins to be arranged for Alemite lubrication and must have 1/8" draw in crosshead. Bronze rings to be applied in crosshead to prevent galling of main rod per A.A.R. standard practice.

CYLINDER COCKS, AIR OPERATED

Air operated cylinder cocks as shown on drawing must be applied to cylinders in manner shown on drawing. Piping to consist of 1/2" O.D. No. 14 BWG and 3/8" O.D. No. 16 BWG copper tubing and 3/8" iron pipe. Pipe line not to be applied inside of drivers.

Air to be taken from main reservoir line.

Cylinder cocks to be applied at destination. One set will be furnished locomotive builder for use when testing locomotives. This set must be returned with last locomotive. Piping and fittings required for the application of cylinder cocks must be furnished by the locomotive builder.

CYLINDERS AND STEAM CHESTS

Cylinders and steam chests as shown on drawings to be cast integral with engine beds.

Cylinder barrels must be fitted with Hunt-Spiller gun iron removable bushings, 26" inside diameter, having a two-stage fit. The second stage of the fit is to commence at center of cylinder barrel and extend to the end of the barrel. The difference in diameter of the two stages of fit is to be 1/32" as shown on drawing. Bushings pressed in from front of cylinder at not less than 35-tons nor more than 50-tons.

Crosshead pins to be arranged for Alemite lubrication and must have 1/8" drain grooves. [illegible] rings to be applied in grooves to prevent pulling of main rod per A.C.L. standard practice.

CYLINDER COCKS, AIR OPERATED

Air operated cylinder cocks as shown on drawing must be applied to cylinders in manner shown on drawing. Piping to consist of 1/2" O.D. No. 14 BWG and 3/4" O.D. No. 16 BWG copper tubing and 3/8" iron pipe. Pipe line not to be applied inside of drivers.

Air to be taken from main reservoir line.

Cylinder cocks to be applied as designated. One set will be furnished locomotive builder for use when testing locomotives. This set must be returned with last locomotive. Piping and fittings required for the application of cylinder cocks must be furnished by the locomotive builder.

CYLINDERS AND STEAM CHESTS

Cylinders and steam chests as shown on drawings to be cast integral with engine beds.

Cylinder barrels must be fitted with Hunt-Spiller gun iron removable bushings, [illegible]" inside diameter, having [illegible] fit. The second [illegible] of the fit is to commence at center of cylinder barrel and extend to the end of the barrel. The difference in diameter of the two stages of fit is to be 1/32" as shown on drawing. Bushings pressed in from front of cylinder [illegible] not less than 40-tons nor more than 60-tons.

Steam chest valve chambers must be fitted with Hunt-Spiller gun iron removable bushings 12" inside diameter, having a two-stage fit and with one stop lug located on horizontal centerline projecting out and contacting steam chest head. Bushings for valve chambers must be pressed in at a pressure of not less than 20 tons nor more than 30 tons.

Cylinder heads, as shown on drawing, must be of cast steel, annealed, designed to suit Locomotive Finished Material Company's light weight pistons, and steam chest and cylinder head studs must be made of Mayari engine bolt steel or alternate nickel steel, SAE-2115. Studs securing front cylinder heads must be grooved as shown on drawing to allow for breakage under excessive pressures. Cylinders and cylinder heads must be tested under a hydrostatic pressure of 100 lbs. per sq. in.

Joints between cylinder heads and cylinders to be ground to insure a good fit. Three stud holes in each cylinder head to be tapped for 1-3/8" standard bolt thread equally spaced for application of eyebolts to facilitate removing heads.

Clearance volumes between pistons and cylinder heads must be measured and reported for each engine.

Cylinders must be lagged with Johns-Manville 85% magnesia boiler covering, cased with No.14 U.S. standard gage Locomotive Boiler Jacket steel and provided with cylinder

Steam chest valve chambers must be fitted with
bushings
Hunt-Spiller gun iron removable [illegible] inside diameter, [illegible] [illegible] and [illegible] one stop lug located on horizontal centerline projecting out and centering steam chest head. Bushings for valve chambers must be pressed in at a pressure of not less than 20 tons nor more than 30 tons.

Cylinder bodies, steam chests, [illegible], must be of cast steel, annealed, [illegible] with Locomotive Finished Material Company's [illegible] patent process, and steam chest and cylinder head studs must be made of [illegible] steel or [illegible] nickel steel S.E.-2115-- [illegible]. Front cylinder heads must be grooved as [illegible] drawing to allow for breakage under excessive pressures. Cylinders and cylinder heads must be tested under a hydrostatic pressure of 100 lbs. per sq. inch.

Joints between cylinder heads and cylinders to be ground to [illegible] fit. Three stud holes in each cylinder head to be tapped for 1-3/8" standard bolt [illegible] for application of eyebolts to facilitate removing heads.

Clearance volume between pistons and cylinder heads must be measured and reported for each engine.

Cylinders must be [illegible] with No. [illegible] boiler [illegible] with [illegible] standard [illegible] line [illegible] drop [illegible] with cylinder and steam chest head casings of pressed steel.

"OKADEE" automatic drain cocks to be applied to exhaust cavity of each cylinder as shown on drawing.

Cylinders to be blown out at 300 pounds steam pressure before leaving builder's works.

FLANGE LUBRICATORS

Flange lubricators as shown on drawings must be applied by locomotive builder to lubricate the flanges of the following wheels: Front of engine truck wheels, front of first pair of drivers, front of rear pair of trailing truck wheels.

Flange oil cups to be located and secured as shown on drawings, Lubricator cups must be applied above centerline of wheels so that oil will feed properly on flange.

Bolts securing clamps, brackets, in connection with flange lubricator piping to be provided with Hi-Power spring washers.

GUIDES

Guides, as shown on drawing, for multiple bearing type cross heads must be applied. Guides to be made of forged steel normalized and drawn in accordance with Material Specification C.S.-2C and secured to back cylinder heads and guide support cast integral with engine bed as shown on drawing. Guide bar bolts to be made of MAYARI engine bolt steel or alternate nickel steel, SAE-2115, and must be equipped with Hi-Power spring washers and washer retainers as shown on drawing.

JOINT RINGS

All ball joint rings applied must be cast iron.

LUBRICATION, HYDROSTATIC OIL

Nathan three-feed, five-point, type 1918 Bull's Eye hydrostatic lubricator, No. 11, to be furnished by the Locomotive Builder and must be applied at an angle of 45° to the back head of the boiler, with one feed connected to feedwater heater hot water pump, one feed to booster, and the remaining feed blanked off. Boiler valve must be A.A.R. Standard. Lubricator to be filled with valve oil.

LUBRICATION, MECHANICAL OIL (CHASSIS)

Nathan fourteen single-feed, thirty-six pint, type DV-7 Mechanical lubricator to be furnished by the Railroad Company and must be applied on the left side of the locomotive. Lubricator to be operated from link of valve gear and feeds must be connected as follows:

8-feeds : one direct to each driving box for journal lubrication.

4-feeds : each to a Nathan #3515 four-way oil distributor provided for each pair of driving boxes to supply lubrication to driving box shoe and wedge faces. One outlet from four-way distributor to go to each shoe and wedge face, right and left.

1-feed : to a Nathan #3515 four-way oil distributor; outlets from distributor to supply lubrication to right and left steam chest valve stem crosshead guides, two outlets from distributor to be connected to each guide.

1-feed : to a Nathan #3515 four-way oil distributor to supply lubrication to engine truck boxes; one outlet from distributor to be connected to each box for journal lubrication.

The above arrangement will require six Nathan #3515 four-way oil distributors, to be furnished by the Railroad Company. Nathan type terminal checks to be furnished by the Locomotive Builder and applied on all oil lines as close as possible to point to be lubricated. Oil piping to consist of 3/8" O.D. copper tubing double annealed, 1/4" cold drawn seamless steel tubing and DeVibliss 3/8" I.D. two-braid Thiokol-lined fluid hose #H-1233 or equivalent. Hose clamps to be of the cast brass type. All oil piping to be substantially clamped to prevent vibration and exposed portions of piping to be covered with Unarco weatherproof asbestos tubing Style 714, 3/8" I.D., single thickness, or alternate Johns-Manville material.

Lubricator to be filled with journal box oil conforming to Specification SP-111-N, Grade "A", and is

[illegible]: [illegible] [illegible] four-way oil distri-
butor; outlets from distributor to
supply lubrication to right and left
[illegible] [illegible] crossheads guides,
two outlets from distributor to be con-
nected to each other.

Lever [illegible] [illegible] four-way oil distri-
butor to supply lubrication to each of
[illegible] boxes; one outlet from distributor
to be connected to [illegible] box for journal
lubrication.

The above arrangement will require six [illegible] four-way oil distributors, to be furnished by the Railway Company. [illegible] type for final checks to be furnished by the Locomotive Builder and installed on all oil lines as close as possible to point to be lubricated. Oil piping to consist of [illegible] O.D. copper tubing double annealed, 1/4" cold drawn seamless steel tubing and Dayton [illegible] 1/4" I.D. [illegible] braid [illegible]-lined [illegible] hose [illegible] or equivalent. Hose clamps to be of the [illegible] type. All oil piping to be substantially clamped to prevent vibration and exposed portions of piping to be covered with [illegible] weatherproof asbestos tubing Style [illegible] 1/2" I.D., single thickness.

Lubricator to be fitted with journal box oil conforming to specification [illegible], [illegible] "A", and is
[illegible]

to be plainly marked in raised letters "J.B.OIL". Heater pipe to mechanical lubricator to be supplied with steam from saturated turret and located under boiler jacket. Heat control valve to be located adjacent to lubricator.

Arrangement to be made for operating mechanical lubricator while locomotive is in transit in order to provide oil to driving journals, engine truck journals, and shoe and wedge faces.

LUBRICATION, MECHANICAL OIL (CYLINDER, ETC)

Nathan eight single-feed, twenty pint type DV-4 mechanical lubricator or alternate Detroit lubricator to be furnished by the Railroad Company and must be applied to right side of locomotive. Lubricator to be operated from link of valve gear and feeds must be connected as follows:

2-feeds : one to each main cylinder
2-feeds : one to each steam chest
4-feeds : two to top of each main crosshead guide

Four Nathan Type "DA" terminal checks to be furnished by the Railroad Company with each lubricator for steam chest and cylinder lines. Guide terminal checks to be furnished by the Locomotive Builder. Terminal checks to be connected directly to oil pipe studs and to be applied in locations where they will be accessible for adjustment. Pipes must be substantially clamped to prevent vibration.

Lubricator to be filled with valve oil and is to be plainly marked in raised letters "VALVE OIL". Heater pipe to mechanical lubricator to be supplied with steam from saturated turret and located under boiler jacket. Heat control valve to be located adjacent to lubricator.

Support for mechanical lubricator must be designed so that either Nathan or Detroit lubricator can be applied without change of support.

LUBRICATORS, DRIVING BOX

Spring pad lubricator as shown on drawing to be applied in each driving box cellar for the purpose of lubricating driving journals. Lubricators to be furnished by the Railroad Company and must be allowed to soak in oil at 70° F for at least 24 hours before being placed in driving box cellars.

OIL CUPS

Oil cups, as shown on drawing, must be applied where required.

PACKING, PISTON ROD AND VALVE STEM

Paxton-Mitchell metallic packing, as shown on drawings, must be applied to piston rod and valve stem.

PISTON HEADS

Piston heads to be of light weight design alloy steel, provided with bronze packing rings, three per piston, manufactured by the Locomotive Finished Material Company, Atchison, Kansas; all as shown on drawing.

Lubricator to be filled with valve oil and is to be plainly marked in raised letters "VALVE OIL". Feeder pipe to mechanical lubricator to be supplied with steam from saturated turret and located under boiler jacket. Heat control valve to be located adjacent to lubricator.

Support for mechanical lubricator must be designed so that either Nathan or [illegible] lubricator can be applied without change of support.

LUBRICANT, DRIVING BOX

Spring and plunger [illegible] as shown on drawing to be applied in each driving box cellar. [illegible] lubricators to be furnished by the railroad company and must be allowed to soak in oil at [illegible]° for at least 24 hours before being placed in driving box cellars.

OIL CUPS

Oil cups, as shown on drawing, must be applied where required.

PACKING, PISTON ROD AND VALVE STEM

Paxton-Mitchell metallic packing, as shown on drawing, must be applied to piston rod and valve stem.

PISTON HEADS

Piston heads to be of lightweight design alloy steel, provided with [illegible] [illegible] rings, three per piston, as required by the Locomotive [illegible] Company, [illegible], [illegible] as shown on drawing.

PISTON RODS

Piston rods must be in accordance with drawing furnished. Material to be in accordance with Specification C.S. 2-C. Piston rods must be rolled.

RELIEF VALVE

A.A.R. Standard 1" Globe valves to serve as relief valves as shown on drawings must be applied to steam chests of cylinders.

REVERSE GEAR

Alco Type "G" power reverse gear equipped for Alemite lubrication as shown on drawing and operated by air must be applied in front of cab on right side of engine with operating rod extending into cab and operating lever secured to boiler.

A steam connection to the power reverse gear with a valve located within easy reach of engineer as shown on drawings, must be provided for use in case of emergency.

Suitable stops must be provided on reverse gear to prevent over-travel of link blocks in reverse links.

Reverse lever indicator must be located on side of quadrant next to engineer and cut-off must be marked in percent so that it can be easily read. Markings to indicate cut-offs of 73½%, 60%, 35%, 25% and center.

Reverse lever quadrant to be blanked off so that engine cannot be hooked up in the forward gear less than 25% cut-off.

SPRING RIGGING

Springs must be secured to a system of forged steel equalizing beams, spring saddles and spring stirrups and double-refined iron spring hangers in accordance with Material Specifications and of designs shown on drawings, except that all cast steel parts shown are to be changed to forged steel. Forgings must be designed to be interchangeable with cast steel parts shown on drawings.

All forged steel parts of spring rigging must be in accordance with A.A.R. Specification M-102, latest revision, Grade "2". All wrought iron parts to be in accordance with A.A.R. Specification M-302, latest revision, Grade "A", double-refined.

Equalizing beams between drivers must be offset vertically to stabilize engine, and 1/4" manganese steel wear plates must be applied to all equalizing beams and seats to prevent excessive wear.

Flexible spring hangers must be provided to take the lateral movement on the lateral motion (No. 1) drivers and must be of design shown on drawings, except that parts are to be made of forged steel.

Excello Corporation's "EX-CELL-O" pins and bushings to be applied to equalizers and hangers. Oil holes must be provided for lubrication of all pin bearings. Enlarging ends of hangers by welding on a boss will not be permitted.

Springs must be secured to a system of forged steel equalizing beams, spring saddles and spring stirrups and double-refined iron spring hangers in accordance with Material Specifications and of designs shown on drawings, except that all cast steel parts shown are to be changed to forged steel. Forgings must be designed to be interchangeable with cast steel parts shown on drawings.

All forged steel parts of spring rigging must be in accordance with A.A.R. Specification M-102, latest revision, Grade "B". All wrought iron parts to be in accordance with A.A.R. Specification M-302, latest revision, Grade "A", double-refined.

Equalizing beams between drivers must be offset vertically to stabilize engine, and 1/4" manganese steel wear plates must be applied to all equalizing beams and seats to prevent excessive wear.

Flexible spring hangers must be provided to take the lateral movement on the lateral motion (No. 1) drivers and must be of design shown on drawings, except that parts are to be made of forged steel.

Franklin Corporation's "CASE-HARDENED" pins and bushings to be applied to equalizers and hangers. Oil holes must be provided for lubrication of all pin bearings. Enlarge ends of hangers by welding when holes fill not be case-hardened.

Bearing of equalizing beams on driving boxes to be lubricated with oil in manner shown on drawing.

Coil springs to be provided at back end of trailing truck equalization system.

SPRING WASHERS

Improved Hi-Power spring washers manufactured by the National Lock Washer Company must be applied to the following: - guide bolts, frame pedestal binder bolts, air compressor supports, main air reservoir brackets, engine and trailing truck pedestal binders and driving box wedges, and other parts subject to vibration or specified elsewhere. Spring washers used on guide bar bolts to be equipped with retainers as shown on drawing.

SPRINGS, DRIVING

Driving springs of the half-elliptic reverse camber type similar to design shown on drawing except made of silico-manganese spring steel in accordance with ASTM Spec. 59 or S.A.E. 9260. Spring end clips to be cast steel in accordance with A.A.R. Specification M-201, latest revision, Grade "B".

THROTTLE LEVER AND OPERATING MECHANISM

Throttle hand lever and handle made of steel to be located on engineer's side of cab within convenient reach from seat box, in location shown on drawing. Throttle lever to be provided with spring loaded latch made of medium carbon steel in accordance with Material Specification C.S.-2-C. Latch to be operated by latch handle and links as shown on drawing. Throttle lever

quandrant made of cold rolled, case-hardened steel and throttle lever to be supported by cast steel fulcrum which in turn is to be supported by cast steel support bracket secured to back head of boiler by three 1-1/8" studs. Bracket to be provided with 3/4" diameter brace rod; all as shown on drawings. Material of fulcrum and bracket to be in accordance with A.A.R. Specification M-201, latest revision, Grade "B". Pitch of teeth in quadrant and latch must be 1/8". All pins, bearings, and jaws must be made of mild steel, case-hardened.

Throttle operating rod to be of design shown on drawing, passing through bearing on throttle lever fulcrum and extending outside of boiler on right side of engine. Operating rod to be supported by roller brackets which in turn must be secured to boiler by 3/4" studs provided with cast iron filler blocks. A steel equalizing lever with high carbon steel shaft as shown on drawing must be located on side of boiler between throttle lever in cab and superheater header. Lever to be supported by cast steel support secured to boiler by 7/8" studs. Provision for lubrication of all bearings on throttle lever and rod rigging must be provided as shown on drawings.

In assembling throttle lever bracket, throttle lever, compensating lever and pull rods, special care

must be taken to see that all are in proper alignment to insure easy operation of throttle lever.

Builder must allow Railroad Company's inspector to operate throttle on each locomotive under full steam pressure to be sure throttle lever can be easily operated with one hand, before leaving Builder's Works. Springy lever action or lost motion not acceptable.

TIRE RETAINING CLIPS

Tire retaining clips of forged mild steel will be furnished by the Railroad Company in accordance with drawing and must be electric-welded to each driving and trailing wheel center in locations shown on wheel center drawing. Each clip must bear tightly against outside faces of driving and trailing wheel tires. Tires must be shielded while welding tire clips to wheel centers and under no circumstances must welding arc, flame, or hot welding rod touch tire. Tire will be rejected if so marked while welding.

TIRES, DRIVING

Driving wheel tires 3-1/2" thick must be in accordance with drawing, bored and flanged to agree with AAR standard gauges, and held in place by shrinkage and shoulder. Outer surface of tires, including periphery and sides, must be trued up in lathe after being shrunk on wheel centers. Tires must be bored straight and within a tolerance of + .003", - .003" from required diameter. All tires must be of the same diameter within a tolerance of 1/8" in circumference

or 1/32" in diameter in the same set.

VALVE, STEAM CHEST

Steam chest valves must be of the balanced piston type, 12" diameter, internal admission, as shown on drawing.

VALVE MOTION

The piston valves must be operated by Walschaert direct link motion. Gear must be properly aligned and adjusted, designed to give a maximum cut-off of 73-1/2% of stroke, and adjusted to cut off equally at 50% stroke.

Maximum valve travel	7-1/4"
Steam lap	1-3/4"
Lead	1/4"
Exhaust Clearance	3/16"
Main Steam Ports	27.2" long by 2-7/16" wide

Valve setting must be checked by rollers or trailing test after valve motion parts are assembled and setting must be rechecked after any changes are made.

Valve motion parts to be of designs shown on drawings furnished.

Reverse links, and link blocks, must be of mild carbon steel, well case-hardened, in accordance with AAR Specification M-102, latest revision, Grade "1".

Link blocks must be bushed with gear bronze in accordance with Material Specification C.S. 12-G, Section 6.

Link block must be at bottom of link when reverse lever handle is down in the corner in the forward motion; link blocks must clear top and bottom of link by 3/4" when in the corner in either forward or back-up motion.

Reverse link trunnions must be 2-5/8" diameter and fitted with case-hardened sleeves of 3-1/4" outside diameter steel tubing welded on.

Breakdown bolts to be applied to centers of link trunnions as shown on drawing.

Link cheek plates must be of forged steel annealed in accordance with AAR Specification M-102, latest revision, Grade "2". Cheek plates must be secured to links by four 1" tapered bolts with castle nuts. Nuts to be secured from turning by No. 4 solid steel taper pins. Link cheeks to be finished all over as indicated on drawing. No welding allowed on link cheeks other than at lubricator pin and at trunnion bushings.

Reverse link supports, as shown on drawing, must be of cast steel in accordance with AAR specification M-201, latest revision, Grade "B", and provided with separate bronze bushings.

Reverse shafts with arms forged on must be applied as shown on drawing. Material of reverse shafts to be forged steel in accordance with A.A.R. Specification M-102, latest revision, Grade "2".

Motion work pins and nuts must be of best grade of mild carbon steel, well case-hardened, and applied as shown on drawings.

Valve stem crosshead must be of forged steel in accordance with AAR Specification M-102, latest revision, Grade "3". Valve stem crosshead guides to be of cast iron.

Valve motion rods, including radius rod lifters, combination levers, combination links and eccentric cranks must be medium carbon steel, normalized and drawn in accordance with Specification C.S. 2-C.

Radius rods and eccentric rods must be mild carbon steel in accordance with AAR Specification M-102, latest revision, Grade "2".

The area of the cross section of the ingot shall be at least four times that of the finished forging.

Provision must be made for internal lubrication of eccentric rod pin and eccentric crank pin.

Rods to be finished smooth and polished with corners ground or draw filed 1/8" radius and must be free from nicks and burrs.

Valve motion rods must be suitably crated to protect them from being nicked during shipment of locomotives.

VALVE MOTION PARTS, ETC. TESTING OF

Valve motion parts, as well as axles, main and side rods, crank pins, side rod knuckle pins, eccentric

Motion work pins and nuts must be of best grade of mild carbon steel, well case-hardened, and applied as shown on drawings.

Valve stem crosshead must be of forged steel in accordance with A.R. Specification M-102, latest revision, Grade "B". Valve stem crosshead guides to be of cast iron.

Valve motion rods, including radius rod lifters, combination levers, combination links and eccentric cranks must be medium carbon steel, normalized and drawn in accordance with Specification C.S. 2-C.

Radius rods and eccentric rods must be mild carbon steel in accordance with A.R. Specification M-102, latest revision, Grade "B".

The area of the cross section of the ingot shall be at least four times that of the finished forging.

Provision must be made for internal lubrication of eccentric rod pin and eccentric crank pin.

Rods to be finished smooth and polished with corners rounded or [illegible] 1/8" radius and must be free from nicks and burrs.

Valve motion work must be suitably crated to protect same from being damaged during shipment of locomotives.

VALVE MOTION
[illegible], ETC.
[illegible]

Valve motion parts, as well as axles, main and side rods, crank pins, [illegible] eccentric rods, eccentric cranks, eccentric pins, valve motion pins, piston rods, valve rods, and crossheads must be tested by the Magnaflux method to detect cracks, flaws, and other defects.

VALVE RINGS

Valve rings to be bronze of the Duplex Sectional Type made by the Hunt-Spiller Manufacturing Corporation, complete with Gun Iron bull ring and springs. All as shown on drawing.

VALVE STEM, STEAM CHEST

Valve stems must be of carbon steel in accordance with Material Specification C.S. 2-C.

Valve stem must be of design shown on drawing, 2" in diameter, and secured to valve spiders by forged steel keys. Valve end of stem to be threaded, 8 threads per inch, U.S. Form, and to be provided with castle nut properly secured from working off by No.7 solid steel taper pin. All as shown on drawing. Use of cotter pin for securing castle nut not permitted.

WHEEL CENTERS

General Steel Castings Corporation's cast steel annealed "BOXPOK" driving wheel centers, as shown on drawings, must be applied with main wheel center modified to suit enlarged crank pin. Alternate to be Baldwin Disc wheel centers or equivalent design approved by the Railroad Company. Material must be in accordance with AAR Specification M-201, latest revision, Grade "B", and centers must be 73" finished outside diameter within a tolerance + .003", - .003".

Wheel centers must be cast accurately to dimensions shown on drawings, must be turned to agree with AAR gauges, and must be pressed on driving axles at a mounting pressure of not less than 10 tons nor more than 15 tons per inch diameter of fit. Inside wheel hub faces must be machined smooth and then rolled.

Wheel centers, after being mounted, but before tires are applied, must be placed in quartering machine and the holes for crank pins bored out, correct both as to stroke and quarter and pins then applied.

To obtain full gripping effect, both the tire and wheel center must have a smooth finish, free from rust, dirt, paint, etc., before tire is applied.

Presses for mounting wheel centers must be equipped with recording device so that pressure can be read for the entire length of axle fit. Gage between inside of driving tires must be 4' 5-1/4" except third pair which must be 4' 5-1/8".

Machining tolerance on diameter of holes bored in cast steel wheel centers for driving axles and crank pins to be + .015", - .015", from nominal diameter; allowance for fit to be made on axle.

Bronze wear plates similar to those shown on drawing to be set in outside faces of 2nd and 3rd driving wheel centers at crank pin holes to prevent wear of Hunt-Spiller bushings.

WHEEL CENTERS, COUNTERBALANCING OF

Locomotives must be cross counterbalanced in accordance with latest A.A.R. recommended practice, except as modified by this specification. Dynamic augment must not exceed 50% of static wheel load at a speed of 106 miles per hour.

Each driving wheel must be fully balanced for all revolving weights bearing on crank pin, including weight of crank pin and hub. Main counterweight must include the weight of equivalent revolving effect of main rod as determined by pendulum test, and the correct proportion of weight of the eccentric crank as determined from the location of its center of gravity. Main driving wheels must be cross counterbalanced; front, intermediate, and back wheels are to have the counterweights directly opposite the crank pins, but their cross balance effects are to be allowed for in determining dynamic augments.

In addition to above, not less than 37% or more than 40% of the weight of reciprocating parts is to be counterbalanced. The reciprocating weight is to be taken as the sum of weights of piston, piston rod, crosshead, and union link, complete with all attachments, plus the difference between the total weight of the main rod and the equivalent revolving effect. The balance for reciprocating parts is to be distributed so as to obtain the maximum dynamic augments

[illegible] CENTERS,
COUNTERBAL-
ANCING OF

Locomotives must be cross-counterbalanced in accordance with latest A.A.R. recommended practice, except as modified by this specification. Dynamic augment must not exceed 50% of static wheel load at a speed of 100 miles per hour.

Each driving wheel must be fully balanced for all revolving weights bearing on crank pin, including weight of crank pin and hub. Main counterweight must include the weight of equivalent revolving effect of main rod as determined by pendulum test, and the correct proportion of weight of the eccentric crank as determined from the location of its center of gravity. Main driving wheels must be cross counterbalanced; front, intermediate, and back wheels are to have the counterweights directly opposite the crank pins, but their cross balance effects are to be allowed for in determining dynamic augments.

In addition to above, not less than 30% or more than 40% of the weight of reciprocating parts is to be counterbalanced. The reciprocating weight is to be taken as the sum of weights of piston, piston rod, crosshead, and union link, complete with all attachments, plus the difference between the total weight of the main rod and the equivalent revolving effect. The balance for reciprocating parts is to be distributed so as to obtain the minimum dynamic augments on the front, intermediate, and back wheels, the overbalance in the main wheels to be kept as low as possible and still balance the required percentage of reciprocating parts, but must not be less than 100 lb.

Builder will be required to furnish Superintendent of Motive Power certified form as per Sketch S-3947 for each locomotive, together with reports of pendulum tests on two main rods, and statement showing center of gravity of eccentric crank.

WHEELS IN TRAM

All wheels under locomotive must be in tram before rods are applied.

ENGINE TRUCK

DESIGN

General Steel Castings Corporation's four wheel inside bearing, swing motion type truck, having cast steel frame, with rocker seat pedestals, etc., cast integral with same, as shown on drawing, must be applied. Rocker seats to be equipped with manganese steel liners. Care must be taken to see that truck is square with centerline of engine and that wheels are in tram.

Engine truck to have 30% initial and 15% constant resistance at rockers subject to check by builder and Railroad Company's representative.

AXLES

Engine truck axles must be steel in accordance with Material Specification C.S. 2-C and must be of design shown on drawing, with journals 7-1/2" in diameter and 14" long. Journals must be rolled and ends of axles finished smooth. Engine truck axles must be machined and then ground or rolled between journals by locomotive builder.

CENTER CASTING

Top center casting must be cast integral with engine bed as shown on drawing and fitted with wearing plate complete for oil lubrication. Grooved bronze washers of material and design shown on drawing must be applied under engine truck center plates.

EQUALIZERS

Engine truck equalizers must be of mild forged steel in accordance with A.A.R.Specification M-102, latest revision Grade "2", and as shown on drawing.

FRAME

Engine truck frame to be cast steel, cast true and smooth, having swing frame and pedestals cast

integral with same and provided with pads, wearing plates and bushings. Frame to be machined where indicated on drawing. Hardened spring steel pedestal liners and manganese steel rocker seat liners must be furnished and applied by the engine truck manufacturer.

JOURNAL BEARINGS

Engine truck bearings for 7-1/2" x 14" journals, as shown on drawing, must be of the Satco Self-Cooling Oil Tube Type, manufactured by the Magnus Company, Inc.

Bearings must be finished to dimensions shown on drawings. Sharp edges on Satco metal to be relieved on both sides and bearings must be spotted when applying to journals to insure even contact.

JOURNAL BOX CELLARS

Engine truck journal box cellars must be made of cast brass to dimensions shown on drawing with cast brass dust guard having 1/4" thick "Corprene" insert applied to inner wall of cellar. Dust guard to be held in place by tempered flat steel spring. Hard felt pads to project through bottom portion of outer wall of cellar and to extend 1/8" beyond Satco metal face of box for the purpose of lubricating hub face of wheel. Felt pads to be saturated in oil for twelve hours before applying cellars to boxes. Oil sight gauge made of brass to be applied to inner face of cellar in location shown on drawing. Sight gauge to be secured by six #8 brass machine screws. 1/16" cork gasket to be provided with sight gauge. Wearing

plate made of #14 gauge sheet steel to be applied on bottom of cellar. Cellars to be held in place by two spring loaded locking levers pivoted on journal box. Locking lugs on cellars to be provided with spring steel wearing plates cast into cellar. Locking lever studs to be made of Mayari engine bolt steel or equivalent nickel steel SAE-2115. All as shown on drawings. Clearance between radius on cellar and journal must be not less than 1/16" nor more than 1/8".

JOURNAL BOXES

Engine truck boxes must be of cast steel of design shown on drawing. Wheel faces of boxes and pedestal jaws must be finished smooth. Hub lining to be made of Satco metal cast on with bronze inserts. Oil grooves for lubricating hub face to be provided as shown on drawing. Boxes must be made to fit standard gages. Engine truck boxes must be thoroughly oiled with journal box oil in accordance with Material Specification SP-111 N. Oil soaked wool waste must be used on top of boxes as shown on drawing.

JOURNAL LUBRICATORS

Engine truck journal lubricators of the spring pad type as shown on drawing must be applied. Lubricators will be furnished by the Railroad Company. Lubricators must be allowed to soak in oil at 70° F at least 24 hours before being placed in journal boxes.

plate made of #16 gauge sheet steel to be applied on bottom of cellar. Cellars to be held in place by two spring loaded locking levers pivoted on journal box. Locking lugs on cellars to be provided with spring steel wearing plates cast into cellar. Locking lever studs to be made of [illegible] angle bolt steel or equivalent nickel steel SAE-2115. All as shown on drawings. Clearance between radius on cellar and journal must be not less than 3/16" nor more than 1/4".

JOURNAL BOXES

Engine truck boxes must be of cast steel of design shown on drawing. Wheel faces of boxes and pedestal jaws must be finished smooth. Hub lining to be made of babbitt metal cast on with bronze inserts. Oil grooves for lubricating hub faces to be provided as shown on drawing. Boxes must be made to fit standard gauges. Engine truck boxes must be thoroughly oiled with journal box oil in accordance with Material Specification SP-111 M. All cooked wool waste must be used on tender boxes as shown on drawing.

JOURNAL LUBRICATORS ETC.

In the truck journal lubricators of the spring pad type as shown on drawing must be applied. Lubricators will be furnished by the Railroad Company. Lubricators must be allowed to soak in oil at 70° F at least 24 hours before being placed in journal boxes.

SAFETY CHAINS

Engine truck safety chains made of wrought iron to be applied to the two front corners of truck and secured as shown on drawing.

SAFETY DEVICE, DERAILMENT

Engine truck derailment safety device similar to that shown on drawing must be applied to prevent excessive lateral displacement of truck in case of a derailment. Device to consist of a vertical member extending downward as far as clearance limits permit so that if wheels are derailed, rail will become engaged between member and wheel and prevent truck frame from passing over rail.

SPRINGS

Engine truck springs must be of the semi-elliptic type made of silico-manganese spring steel in accordance with ASTM Specification 59 or S.A.E.-9260. Design to be as shown on drawing except springs to have 24 leaves. Spring end clips to be of cast steel in accordance with AAR Spec. M-201, latest revision, Grade "B". Spring hanger pins to be made of Mayari engine bolt steel or equivalent nickel steel SAE-2115.

WHEELS

Engine truck wheels must be of solid wrought steel, as specified, 36" in diameter, machined to AAR standard tread, and must be pressed on axle at a pressure of not less than 10 tons, nor more than 15 tons per inch diameter of wheel fit.

Gage between inside of tires must be 4' 5-3/8" Tolerance of 1/32" under this gage will be allowed.

Inside hub faces on wheels must be machined smooth and then rolled.

TRAILING TRUCK

DESIGN

General Steel Castings Corporation's four-wheel, outside bearing "Delta" type radial truck having cast steel frame with rocker centering devices at back corners of truck frames on right and left hand sides of engine, as shown on drawings, must be applied. Radius bar fulcrum pocket must be equipped with manganese steel wearing plate which is to be furnished by truck manufacturer and applied by builder when erecting locomotive. Design of truck to be modified to provide double coil springs at back end of trailing truck equalizing system.

Trailing truck to have 15% initial and 10% constant resistance at rockers, subject to check by builder and Railroad Company's representative.

AXLES

Trailing truck axles must be steel in accordance with Material Specification C.S..-2-C and must be of design shown on drawing. Journals on front trailing truck axle to the 7" diameter by 14" long and on rear axle to be 9" diameter by 14' long. Journals must be rolled and ends of axles finished smooth.

Wheel center fits on trailing truck axles to be turned taper with larger end of taper at inner end of wheel fit. Taper to be such that inner end of wheel fit will be .003" larger in diameter than outer end; tolerance on taper to be + .001", - .000". Last 1-1/2" from larger end of taper fit to be ground off

on taper established by finished cut, making a continuous tapered surface from tooled portion to ground portion.

Allowance for fit to be measured at outer end of wheel fit and must be such as to obtain a mounting pressure of not less than 10 nor more than 15 tons per inch diameter of wheel fit.

Axle manufacturer to rough bore hollow bore in rear trailing truck axles 1/8" undersize, heat treat axles, and then rebore them to size shown on drawing.

BOOSTER ENGINE

Booster engine shownon drawing, operated at 50% cut-off by superheated steam at 280 lbs. boiler pressure must be applied to drive rear pair of wheels on trailing truck. Pilot fibrous packing must be applied to all pipe ball joints.

Application of booster, including piping and fittings, must be in accordance with Franklin Railway Supply Co's latest recommendations and as shown on drawings.

Booster throttle valve to be located immediately back of steam chest with long length of pipe from valve to booster applied on slope to permit drainage to booster at all times.

EQUALIZERS

Trailing truck equalizers must be of cast steel in accordance with A.A.R. Specification M-201, latest revision, Grade "B". Trailer cross equalizer used

back of rear drivers in front of trailing truck must be of forged steel in accordance with A.A.R. Specification M-102, latest revision - Grade "2". All equalizers must be finished to dimensions shown on drawings.

Equalizers must be properly offset to stabilize rigging and must be provided with the necessary wearing plates, pads, bushings, etc.

FRAME

Trailing truck frame to be cast steel, cast true and smooth. Frame to be similar to that shown on drawing and must be machined where indicated on drawing. Portion of frame between pedestals to be modified to clear journal box lids.

JOURNAL BEARINGS

Trailing truck bearings for 7" x 14" and 9" x 14" journals must be of the Satco Self-Cooling Oil Tube Type manufactured by Magnus Co., Inc. Bearings must be finished to dimensions shown on drawings. Sharp edges on Satco metal must be relieved on both sides and bearings must be spotted when applying to journals to insure even contact.

JOURNAL BOX CELLARS

Trailing truck journal box cellars must be made of cast aluminum alloy of composition and to dimensions shown on drawing with cast brass dust guard having 1/4" thick "Corprene" insert applied to inner wall of cellar. Dust guard to be held in place by tempered flat steel spring. Hard felt pads to project through bottom portion of inner wall of cellar and to extend

1/8" beyond Satco metal face of box for the purpose of lubricating hub face of wheel. Felt pads to be saturated in oil for 12 hours before applying cellars to boxes. Oil sight gauge made of brass to be applied to outer face of cellar in location shown on drawing. Sight gauge to be secured by six#8 brass machine screws. 1/16" cork gasket to be provided with sight gauge. Wearing plate made of #14 gauge sheet steel to be applied on bottom of cellar. Cellar to be held in place by two spring loaded locking levers pivoted on journal box. Locking lugs on cellars to be provided with spring steel wearing plates cast into cellar. Locking lever studs to be made of Mayari engine bolt steel or equivalent nickel steel SAE-2115. All as shown on drawings. Clearance between radius on cellar and journal must be not less than 1/16" nor more than 1/8".

JOURNAL
BOX LIDS

Trailing truck journal box lids to be made of cast malleable iron 3/16" thick manufactured by the Symington Company as shown on drawing. The words "SPRING-PAD LUBRICATOR" to be cast in raised letters 5/8" high on lid. Lid to be held securely shut against journal box by double loop coil spring as shown on drawing. Lid to pivot on spread-end pin in accordance with drawing.

JOURNAL BOXES

Trailing truck boxes must be of cast steel of design shown on drawing. Wheel faces of boxes, pedestal jaws, and lid faces must be finished smooth. Wearing plates made of Tobin bronze to be provided at inner lateral pedestal faces on boxes. Wearing plates to be built up with bronze welding rod. Hub liner to consist of Satco metal face cast on with bronze inserts. All as shown on drawings.

Boxes must be made to fit standard gauges.

Trailing truck journal boxes must be thoroughly oiled with journal box oil in accordance with Material Specification furnished.

Oil soaked wool waste must be used on top of truck boxes for lubricating hub and pedestal faces, as shown on drawing. Steel cover plates must be welded over waste cavities on box.

JOURNAL LUBRICATORS

Trailing truck journal lubricators of the spring pad type, as shown on drawing must be applied. Lubricators will be furnished by Railroad Company.

Lubricators must be allowed to soak in oil at 70° F at least 24 hours before being placed in journal boxes.

SAFETY DEVICE, DERAILMENT

Trailing truck derailment safety device similar to that shown on drawing must be applied to prevent excessive lateral displacement of truck in case of a derailment. Device to consist of a vertical member extending downward as far as clearance limits permit so that if wheels

are derailed, rail will become engaged between member and wheel and prevent truck frame from passing over rail.

SPRINGS

Trailing truck springs must be of the semi-elliptic and double coil types made of spring steel, in accordance with Material Specification C.S. 17-D., and as shown on drawings. Spring end clips to be made of cast steel in accordance with A.A.R. Specification M-201 latest revision.

TIRES, TRAILING WHEEL

Trailing wheel tires 3-3/4" thick 45-1/2" outside diameter must be in accordance with drawing, bored and flanged in accordance with A.A.R. gages and held by shrinkage and shoulder. Outer surface of tires, including periphery and sides, must be trued in lathe after being shrunk on wheel centers. Tires must be bored straight and within a tolerance of + .003", - .003" from required diameter.

Tires must be of the same diameter within a tolerance of 1/16" in circumference in the same pair. Gage between inside of back pair of tires must be 4' 5-3/8" within a tolerance of 1/32" under this gage. Gage between inside of front pair of tires must be 4' 5" within a tolerance of 1/32" over this gage.

WHEEL CENTERS, TRAILING

Trailing wheel centers, 38" diameter, as shown on drawing, must be of cast steel, annealed in accordance with A.A.R. Specification M-201, latest revision -

Grade "B", turned to agree with A.A.R. gages and pressed on axles at a pressure of not less than 10 nor more than 15 tons per inch dia. of wheel fit. Centers must be mounted before tires are applied. Before tires are shrunk on, wheel centers must be trued up in lathe. To obtain full gripping effect, both tires and wheel centers must have a smooth finish, free from rust, dirt, paint, etc. before tires are applied. Outside hub faces on wheels must be machined smooth and then rolled.

Grade "B", turned to conform to A.A.R. [illegible] and pressed on axles at a pressure of not less than 10 nor more than 15 tons per inch dia. of wheel fit. Centers must be mounted before tires are applied. Before tires are shrunk on, wheel centers must be trued up in lathe. To obtain full gripping area, both tires and wheel centers must have a smooth finish, free from rust, dirt, paint, etc. before tires are applied. Outside hub faces on wheel centers to be machined smooth and then painted.

ACCESSORIES

AIR BRAKES AND AIR PIPING

GENERAL

See Specialty Specification L-191 for Foundation Brakes and Air Brake Equipment, including "HSC" high speed electro-pneumatic control equipment. Builder must apply same to locomotives and must furnish and apply such additional parts as are necessary.

Brake pipe pressure must be 110 pounds, and brake power must be based on a pressure of 50 pounds per sq. in. in brake cylinders; brake gear, however, must be designed to stand a brake cylinder pressure of 90 pounds. The brake power must be as follows:

49% of weight on engine truck or 40,750 lbs.

65% of weight on drivers or 172,900 lbs.

50% of weight on rear trailing truck wheels or 29,750 lbs.

Brakes to be applied to all engine truck wheels, all driving wheels, and rear trailing truck wheels.

If necessary foundation brake rigging to be modified to permit removal and reapplication of driving box cellars without having to remove binders or disconnect brake rigging.

AIR BRAKE PIPING

Air Brake piping on locomotive must be extra strong wrought iron pipe with AAR 300 lb. fittings, supported on brackets in a substantial manner. Pipe ends must be reamed to full size after cutting and

all piping must be blown out with steam to remove scale, before application to locomotive. All piping must be assembled with as few fittings as possible. The use of bushings is not permitted. All union joints, except where otherwise specified, must be connected with "Corley A.A.R." ball joint unions. Piping must be applied so that flexible and rigid staybolts can be readily removed. Pipes must not pass over either staybolts or washout plugs. Red or white lead must not be used on pipe joints. Plumbago may be used. Pipes must not be located closer than 2-1/2" from boiler jacket.

AIR COMPRESSORS

Two 8-1/2" cross-compound air compressors complete with 2" G-suction filter operated by superheated steam must be applied on left side of boiler in location shown on drawing. Door as shown on drawing to be provided in running board skirting to permit access to air compressors.

Compressor supports must be of forged steel of substantial construction, and must be accurately aligned. Compressors must be free from vibration when working at full capacity.

All piping must be extra strong with A.A.R. 300 lb. fittings and located where it will be readily accessible. Exhaust pipes from air compressors to be 2" extra strong wrought iron pipe.

Each air compressor must be fitted with automatic drain cocks and drain pans.

Air compressor throttle valve must be A.A.R. standard type made of Monel metal suitable for superheated steam and having outside bonnet and union nut.

Each air compressor to be lubricated by a type "F-1 A" mechanically operated lubricator manufactured by the Westinghouse Air Brake Company. Lubricators are to be applied in accordance with manufacturer's recommendations.

AIR MANIFOLD Cast iron manifold of design shown on drawing to be applied on engineer's side of cab in location shown on drawing. Manifold to supply air to bell ringer, sander, power reverse gear, sand agitator, signal foam meter and air horn.

AUTOMATIC TRAIN CONTROL CLEARANCES Clearances specified on drawing entitled "Automatic Train Control Apparatus Clearances", must be complied with by Builder.

BRAKE PEDESTAL Westinghouse L-8-PC brake valve with pedestal to be applied on engineer's side of cab in location shown on drawing with flat back of pedestal parallel to back head.

BRAKE SHOES Brake shoes for engine truck, driving, and rear trailing wheels will be furnished by Railroad Company and must be in accordance with drawings furnished.

CUT-OUT COCKS

Cut-out cocks must be applied in locations shown on drawing entitled "Air Brake Piping Diagram".

Emergency delay cut-out cock to be located in plain view of, and within easy reach of engineer.

INTERCOOLER

Westinghouse Air Brake Company's air intercooler to be applied transversely across engine in front of smokebox in accordance with manufacturer's recommendations. Suitable shield made of steel creet expanded metal as shown on drawing must be provided to protect intercooler.

MAIN RESERVOIR

Two main reservoirs as specified must be located under running boards;one on right and one on left side of locomotive, as indicated on drawing, and must have a total capacity of not less than 66,000 cubic inches. Both reservoirs to be fitted with two washout plugs, one of which is to be tapped for drain cock.

Pipe connections to main reservoirs must be so arranged that reservoirs can be pulled out from either side of locomotive without disturbing adjacent piping.

PRESSURE RETAINING VALVE

Pressure retaining valve for tender brakes to be applied in cab of locomotive on engineer's side in location shown on drawing. Valve to be connected to remote control diagraphm cock in tender brake cylinder line on engine, together with spring loaded valve, and check valve as shown on drawing.

TEST OF
AIR BRAKES

Air brakes must be tested with a pressure of 120 lbs. per square inch, all joints being first covered with soap suds, and all castings, joints, pipes and their connections must, under that pressure, be free from leakage.

The brakes must be prompt in their action, both when applied and released, being free from all avoidable friction.

STEAM HEAT

GENERAL

Steam heating equipment as shown on drawings and as specified must be applied to locomotive.

SLEEVE JOINT

A 2-1/2" Franklin sleeve joint must be applied for steam heat connection between engine and tender.

STEAM HEAT GAUGE

A 4-1/2" dial steam heat gauge as specified must be provided on Fireman's side of cab in location where it can be easily read from his seat box.

STEAM HEAT PIPING

Piping for steam heat line from turret to reducing valve on engine must be 2-3/4" O.D. copper tubing, No. 10 BWG thickness. Steam heat piping from reducing valve to rear of tender to be 2-1/2" extra strong wrought iron pipe with AAR 300 lb. fittings, and must be applied in accordance with drawing.

STEAM HEAT REDUCING VALVE

A 2-1/2" steam heat reducing valve as specified must be applied outside cab on fireman's side with geared operating mechanism as shown on drawings and extension handle leading into cab to provide for convenient operation from within cab.

STEAM HEAT STOP VALVE

Vapor Car Heating Company's No. 210 stop valve to be applied to turret in location shown on drawing.

FURNITURE AND TOOLS

Engine and tender must be furnished with the following tools, etc. of good quality and workmanship and in accordance with drawings furnished:

2 Cab Arm Rests

2 Cab Awnings

1 Cab Bulletin Board

2 Cab Seats and Tool Boxes (for enginemen)

1 Cab Seat with Arm Rest (for head brakeman)

2 Cab Storm Windows

1 Case Containing 2 Driving Box Cellar Lubricators

1 Chisel, Flat

2 Grease Guns, One for Soft Grease, One for Hard Grease

1 Hammer

1 Jack (25-ton capacity) of any of the following makes:

No.2510-C: The Duff-Norton Manufacturing Co., Pittsburgh, Pa.

No.2510 : The Buda Company, Harvey, Ill.

No.1025 : The Joyce-Cridland Co., Dayton, Ohio

1 Oil Can, Long Spout

1 Oil Can, Two Gallon

1 Oil Gun

1 Packing Hook

1 Packing Iron

1 Pinch Bar

3 Rolls, Valve Pilot Tape (1750 miles)

1 Sand Scoop

1 Oil Can - Three Quart

1 Torch

1 Water Cooler, Drinking

1 Wrench, Alligator

2 Wrenches, Dynamo

1 Wrench, Steam Hose & Conduits

1 Wrench, Sander Nozzle

5 Wrenches, Drop Forged Steel

2 Wrenches, Monkey

SUMMARY

Locomotives must be built in the best, most substantial and workmanlike manner, according to the true intent and meaning of the Specifications, notwithstanding that everything required is not particularly mentioned in this Specification, or shown on drawings.